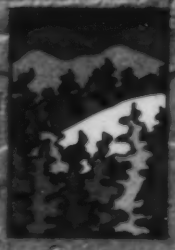
yukon state of the environment report

1995



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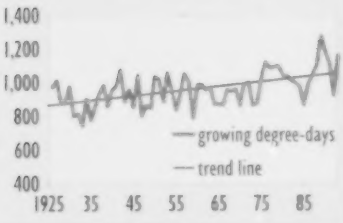
Available from:

Yukon Department of Renewable Resources
Policy and Planning Branch
Box 2703
Whitehorse, Y.T. Y1A 2C6
Phone: (403) 667-5634
Fax: (403) 667-2438

Environment Canada
Canadian Wildlife Service
Mile 917.6B Alaska Highway
Whitehorse, Y.T. Y1A 5X7
Phone: (403) 667-3949
Fax: (403) 667-7962

Total warmth of the growing season in Mayo, 1926-1993



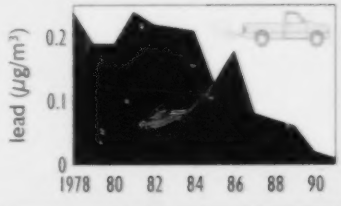
Climate Change and Ozone Depletion

- World-wide average temperatures are increasing. Summer temperatures in the Yukon and northern BC show a slight, but statistically significant, increase since the beginning of the century. The growing season at Mayo has become warmer. Winter temperatures are more variable and show no clear trend. Warmer summers may be due to natural variations in climate or may be associated with global warming from increased greenhouse gases.
- Total emissions of carbon dioxide (a major greenhouse gas) from the burning of fossil fuels in the Yukon were 440,000 tonnes in 1990 – 49 per cent of this was from transportation.
- Since the late 1970s stratospheric ozone thickness has declined. Because the angle of the sun is low at high latitudes, ultraviolet radiation reaching the Yukon due to ozone depletion has probably been small.

Air Quality

- The major sources of air pollution in the Yukon are combustion of fuels and open burning of wastes. Episodes of poor air quality in communities occur on cold, calm winter days when wood smoke and vehicle exhaust are trapped in a lower layer of stagnant air.
- The number of vehicles registered in the Yukon has doubled since 1974, from almost 11,000 to almost 22,000. Whitehorse ranks among the 15 worst of 54 urban Canadian stations measuring carbon monoxide. Vehicle exhaust is the main source. When carbon monoxide concentrations are at their highest levels in downtown Whitehorse, the air is of 'fair' quality according to national standards. The decline in lead in Whitehorse air is due to the phase-out of leaded gasoline in Canada.

Lead in air, downtown Whitehorse, 1978-1991



- Wood is the principal heat source in the Yukon (43 per cent of the population, compared to 6.8 per cent in the rest of Canada). Approximately 16,000 cords of wood are burned annually in Whitehorse (five cords for each wood-burning appliance).

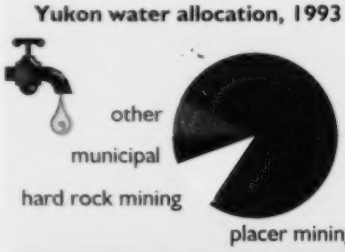
Contaminants in Ecosystems

- Organochlorines such as toxaphene, DDT and PCBs have been found at low levels in Yukon air and snow. The main source is long-range atmospheric transport from other parts of the world. Organochlorines are found in fish throughout the Yukon although in most fish levels are low and fish are safe to eat. However, because organochlorines build up in fat and in predator species, levels can become high in some fish species in a few lakes. Consumption advisories based on toxaphene (a pesticide no longer used in Canada) have been issued for burbot livers and lake trout flesh from Lake Laberge and for burbot livers from Atlin Lake.
- Organochlorines are absent or occur only at very low levels in ducks, grouse, caribou, moose and other game animals.
- Metals are generally within natural ranges and meet consumption guidelines for berries, other food and medicinal plants, fish and wildlife. Mercury is sometimes elevated in large fish, and cadmium is high in the kidneys and livers of caribou, moose and porcupine. The source of both of these metals is natural rock. Cadmium in all wild meat is very low.

Water

- Metals and other constituents of natural waters are generally within guidelines for the protection of freshwater life and drinking water. At some locations, certain metals (including copper, lead and zinc) are seasonally higher because of the erosion of mineralized soils during high water.
- Water quality is affected by mining activities in the central Yukon. The main long-term effect of hard rock mining is the increase in metals, particularly zinc, downstream of some mines.
- Drinking water guidelines were met for most Yukon community water supplies in a 1993 survey. In some supplies, substances such as iron and manganese were higher than recommended levels.

Yukon water allocation, 1993



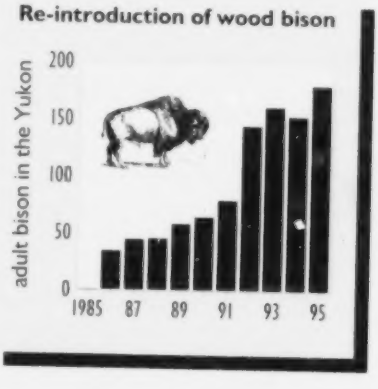
These occur naturally and affect the taste and appearance of water but do not affect human health.

- The main concern with Yukon drinking water is contamination from bacteria, *Giardia* and other pathogens. Health Canada recommends boiling all drinking water taken from lakes or streams. Communities with holding tanks or with private wells are more likely to have bacteria in drinking water samples than communities with piped water systems.
- Bacteria from Whitehorse sewage effluent persist downstream as far as Lake Laberge. This situation is expected to improve when the new sewage treatment system is in operation.

Habitat and Biological Diversity

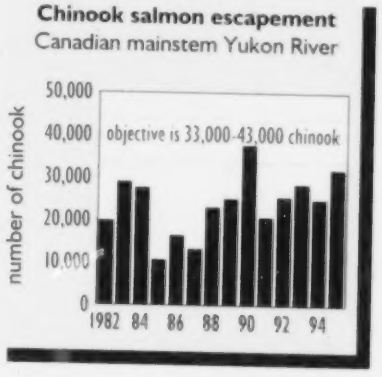
- Expansion of the road network in the Yukon over the past 50 years has led to fragmentation of wildlife habitat.
- Fish habitat and migration have been affected by five hydro-electric dams in the Yukon: Lewes River (1899); North Klondike (1911); Mayo (1954); Whitehorse Rapids (1957); and, Aishihik Lake (1975). Studies show that whitefish reproduction has been poor in Aishihik Lake in some years following dam construction and fluctuating water levels have affected wetlands. Fish ladders have been installed at Lewes and Whitehorse dams and a salmon hatchery operates at Whitehorse.
- Placer mining is the other major activity affecting fish habitat. New standards reduce the amount of sediment allowed in placer mine effluent and require restoration of fish habitat.
- Few Yukon species are faced with extinction and the territory's biodiversity is globally significant.
- There are about 30 species of plants that occur only in the Yukon or in the Yukon and neighbouring parts of Alaska. These plants survived the ice age in unglaciated areas.
- Two Yukon animals, the bowhead whale and the anatum peregrine falcon, are classified as endangered by the Committee on the Status of Endangered Wildlife in Canada. Wood bison are classified as threatened. Yukon animals classified as vulnerable are: the Squanga whitefish, great grey owl, short-eared owl, trumpeter swan, tundra peregrine falcon, wolverine, grizzly bear and polar bear.

Re-introduction of wood bison



- Bison have been extinct in the Yukon for hundreds of years. A herd of 34 bison was introduced to the Yukon in 1985 and has become established.
- The numbers of bowhead whales declined drastically in the western Arctic in the late 1800s, but they recently exhibited a recovery. The Beaufort Sea bowhead population is now the largest population in existence.
- From 1970 to 1978, peregrine falcons in the Yukon declined to only a few. A national recovery plan and reductions in DDT emissions brought about a recovery and there are now over 100 breeding pairs in the territory.

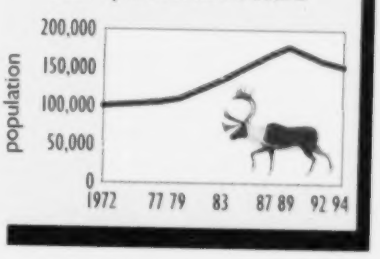
Chinook salmon escapement
Canadian mainstem Yukon River



Animal Populations

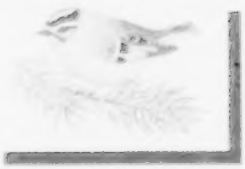
- Yukon River chum salmon stocks have generally declined. Numbers of chum spawning annually in the Fishing Branch River declined from up to 350,000 in the early 1970s to 60,000 or fewer in the 1980s and 1990s. Alsek River sockeye stocks are at moderate levels and are stable. Chinook salmon stocks in the Yukon and Alsek Rivers are below internationally-set target levels but are not declining.
- In some lakes, lake trout are depleted from over-fishing. Actions taken to allow population recovery include reduction of commercial fishing and restriction of the allowable catch for sport fishing.
- There are two Grant's caribou herds in the Yukon: the Porcupine and the Fortymile herds. Gwitchin, Inuvialuit and Inupiat from 13 communities in Alaska, the Yukon and the Northwest Territories rely on the Porcupine Herd for food. Calves are usually born in the Arctic National Wildlife Refuge in Alaska and the herd is vulnerable to potential oil and gas development activity in the Refuge.

Porcupine Caribou Herd



- The Fortymile Caribou Herd, which numbered hundreds of thousands in 1900, has an estimated 1995 population of 20,000. The herd is being harvested primarily in Alaska at a rate that is not considered sustainable. An international working group is addressing this issue.
- The total population of 22 woodland caribou herds is 30,000 to 35,000. In 1994 three herds, Carcross, Aishihik and Chisana, were decreasing and three herds, Tay River, Finlayson and Wolf Lake, were increasing.
- The Yukon moose population is stable at about 60,000. Moose populations have declined in the Aishihik and Carcross areas since 1980, while moose populations increased in the Nisutlin area during the 1980s.
- Wolves number approximately 4,500 in the Yukon. A wildlife conservation program to reverse the decline of caribou and moose populations in the Aishihik-Kluane region included the start of a temporary wolf control program in 1993 to reduce wolf predation on these ungulate species.

Golden-crowned kinglet, inhabitant of old growth forests



- There are 6,000 to 7,000 grizzly bears and 10,000 black bears in the Yukon. Grizzlies are categorized as vulnerable worldwide, but Yukon populations are considered stable.
- Thirty-four species of swans, geese and ducks spend part of their annual cycle in the Yukon.

Wetlands

- There has been little loss of important wetlands. Four wetland areas have protected status, all as a result of land claims settlements since 1984. Some of the smaller wetlands, mainly in southern Yukon, are threatened by residential or agricultural development.
- An estimated average of 300,000 ducks breed on the Old Crow Flats (a wetland of international importance). This nesting habitat is particularly important in times of drought on the Prairies.

Forests

- Forests cover about 60 per cent of the total land area in the Yukon, and Yukon forests make up five per cent of the total forested area in Canada.
- Plant communities are adapted to fire. On average, a given area of Yukon forest burns every 80 to 200 years. Some birds and wildlife, such as the marten, woodland caribou and golden-crowned kinglet, are associated with old forests.

Five-year balance of Yukon forest land harvested and planted

- Major timber harvesting activities in the Yukon started with the Klondike Gold Rush. During 1900, 253,000 cubic metres of wood was used in the Yukon. Forest harvesting peaked in 1994/95 at 419,211 cubic metres. The Watson Lake Forest Region accounted for 86 per cent of that harvest.
- The recent increased demand for Yukon timber has highlighted the need for improved forest management policy and practices. The first Yukon reforestation program began in 1992.

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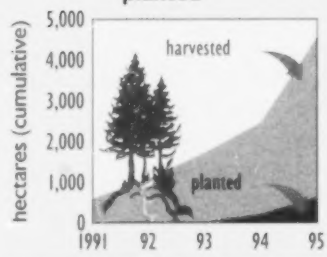

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Rapport sur l'état de l'environnement au Yukon de 1995

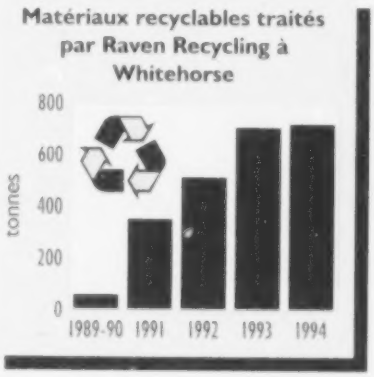
L'établissement de rapports sur l'état de l'environnement traduit un intérêt marqué pour la salubrité de l'environnement au Yukon. Le présent rapport vise à fournir de l'information qui favorisera la prise de décisions éclairées et l'harmonisation des considérations liées à une économie durable et à un environnement sain. Le présent rapport ne présente aucune recommandation, n'établit aucune politique, et ne constitue pas un bilan de l'environnement. Le premier rapport sur l'état de l'environnement au Yukon décrit l'environnement yukonnais et présente des données de base, les nouveaux problèmes environnementaux et les effets cumulatifs. Des rapports annuels seront ensuite publiés et nous aideront à surveiller les changements qui se produisent dans l'environnement. L'information contenue dans ce document est tirée de rapports et de dossiers publiés par le gouvernement et des chercheurs ainsi que de discussions menées avec de nombreux Yukonnais ayant des connaissances particulières sur divers aspects de l'environnement et des activités humaines. Nous devons également souligner la contribution des Aînés des Premières nations qui donnent une vue à long terme de l'environnement du Yukon, de son importance et de sa vitalité.

Faits saillants

Le territoire et la population

- Le Yukon couvre 478 034 km^2; il est caractérisé par un relief surtout montagneux, des forêts boréales et une toundra arctique et alpine. Le pergélisol y est généralisé. La partie septentrionale du territoire est bordée par la mer de Beaufort.
- Soixante-quinze pour cent des 31 000 Yukonnais vivent dans la région de Whitehorse et de ses environs. L'économie du Yukon est tributaire du secteur public, du tourisme, du secteur tertiaire et des industries extractives, comme l'exploitation minière et forestière. La chasse, la pêche et la cueillette des baies sont des activités importantes auxquelles s'adonne une grande partie de la population. Ainsi, le gibier représente entre 27 et 60 p. 100 du panier de provisions des résidants de Ross River, d'Old Crow et de Teslin.

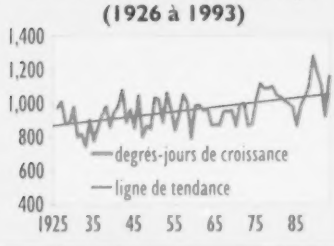
- Environ 80 p. 100 du territoire est constitué d'espaces naturels; cette proportion est bien supérieure à celle observée en Europe (3 p. 100) et dans l'ensemble de l'Amérique du Nord et de l'Amérique centrale (41 p. 100).
- Le réseau a pris beaucoup d'ampleur depuis que la route de l'Alaska, principale voie d'accès, a été aménagée pendant la Seconde Guerre mondiale.
- À peine 1,3 p. 100 de la superficie estimative (6 680 km^2) des terres arables du Yukon ont été aménagées à des fins agricoles. Les terres les plus propices à l'agriculture se trouvent dans les régions de Dawson City, de Stewart River et de Carmacks. Même si les sols y sont moins riches, l'agglomération de Whitehorse représente la principale région agricole.
- Neuf pour cent du territoire (44 735 km^2) fait l'objet d'une protection. Six des 23 écorégions sont représentées dans le réseau des parcs et des zones protégées. De nombreuses zones protégées, dont les parcs d'Ivvavik, de l'île Herschel et Vuntut et la réserve nationale de faune du delta de la rivière Nisutlin, ont été créées dans le cadre du règlement des revendications territoriales.



Les déchets

- Des programmes communautaires de recyclage et de compostage ont été lancés au Yukon au cours des dix dernières années; le volume de déchets ainsi récupérés a augmenté. Jusqu'à 75 p. 100 des déchets solides produits à Whitehorse pourraient être recyclés ou réduits. Parmi les matériaux recyclés à Whitehorse, mentionnons l'aluminium, le papier de bureau, les journaux, les sacs en papier, les boîtes de conserve, le carton ondulé, les bouteilles en plastique pour boissons et les piles.
- Il n'existe aucune installation de stockage sécuritaire des déchets dangereux au Yukon. Les entreprises qui produisent des déchets doivent les entreposer jusqu'à ce qu'ils soient expédiés en vue de leur élimination. Les huiles usées composent jusqu'à 69 p. 100 des déchets dangereux produits au Yukon.

Réchauffement total pendant la saison de croissance à Mayo (1926 à 1993)



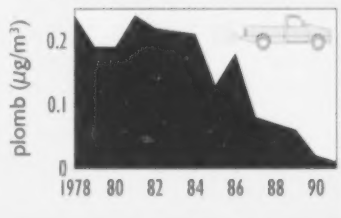
Le changement climatique et l'appauvrissement de l'ozone

- Les températures moyennes augmentent à l'échelle mondiale. Au Yukon et dans le nord de la Colombie-Britannique, les températures estivales ont connu une hausse légère mais statistiquement significative depuis le début du siècle. À Mayo, la saison de croissance est caractérisée par du temps plus chaud. En hiver, les températures sont plus variables et n'affichent aucune tendance nette. Le temps plus chaud en été pourrait être dû à des variations climatiques naturelles ou au réchauffement mondial causé par les gaz à effet de serre.
- Les émissions totales de dioxyde de carbone (important gaz à effet de serre) causées par l'utilisation de combustibles fossiles au Yukon se sont élevées à 440 000 tonnes en 1990, dont 49 p. 100 proviennent du secteur des transports.
- Depuis la fin des années 1970, la couche d'ozone stratosphérique s'est amincie. Comme l'angle formé par le Soleil est faible aux hautes latitudes, la proportion des rayons ultraviolets qui atteignent le Yukon du fait de l'appauvrissement de l'ozone est probablement faible.

La qualité de l'air

- Les combustibles et les déchets brûlés en plein air sont les deux principales sources de la pollution de l'air au Yukon. Les épisodes de pollution de l'air dans les collectivités se produisent par temps froid et non venteux en hiver, lorsque les gaz d'échappement des automobiles et la fumée produite par la combustion du bois sont emprisonnés dans la couche inférieure d'air stagnant.
- Depuis 1974, le nombre de véhicules enregistrés au Yukon a doublé, passant d'environ 11 000 à près de 22 000. La ville de Whitehorse se classe parmi les 15 stations urbaines où sont mesurées les plus fortes concentrations de monoxyde de carbone atmosphérique au Canada. Les gaz d'échappement des véhicules représentent la principale source de pollution. Lorsque les concentrations de monoxyde de carbone sont les plus élevées dans le centre-ville de Whitehorse, la qualité de l'air est passable selon les normes canadiennes. La baisse de la concentration de plomb atmosphérique à Whitehorse est due à l'élimination progressive de l'essence plombée au Canada.

Plomb dans l'air au centre-ville de Whitehorse, 1978-1991



- Le bois est le principal combustible utilisé au Yukon (par 43 p. 100 de la population comparativement à 6,8 p. 100 dans le reste du pays). Environ 16 000 cordes de bois sont brûlées chaque année à Whitehorse (cinq cordes pour chaque appareil alimenté au bois).

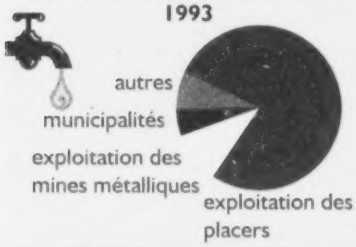
Les contaminants dans les écosystèmes

- Des composés organochlorés comme le toxaphène, le DDT et les BPC ont été décelés en faibles concentrations dans l'air et la neige au Yukon. Le transport atmosphérique à distance de ces polluants utilisés dans d'autres parties du globe constitue la principale source de contamination. Des organochlorés sont décelés dans la chair du poisson partout au Yukon; toutefois, dans la plupart des cas, les concentrations sont faibles et les poissons peuvent être consommés sans danger. Néanmoins, comme ces composés s'accumulent dans les tissus adipeux et dans les espèces prédatrices, les concentrations peuvent être élevées chez certaines espèces de poisson de certains lacs. À cause de la présence de toxaphène (un pesticide qui n'est plus utilisé au Canada), des avis sanitaires limitant la consommation de foie de lotte et de chair du touladi du lac Laberge ainsi que de foie de lotte du lac Atlin ont été émis.
- Les concentrations d'organochlorés sont nulles ou très faibles chez les canards, la gélinotte, le caribou, l'orignal et d'autres espèces de gibier.
- Les concentrations de métaux sont habituellement normales et conformes aux lignes directrices relatives à la consommation de baies, d'autres plantes alimentaires et médicinales, de poisson et d'espèces fauniques. Les concentrations de mercure sont parfois élevées chez les gros poissons, tandis que les teneurs en cadmium sont élevées dans le foie et les reins du caribou, de l'orignal et du porc-épic. Les roches constituent la source de ces deux métaux. La teneur en cadmium dans la viande sauvage est très faible.

L'eau

- Les concentrations de métaux et d'autres éléments présents dans les eaux naturelles sont généralement conformes aux recommandations relatives à la protection des formes de vie en eau douce et à l'eau de boisson. À quelques endroits, la teneur en certains métaux (dont le cuivre, le plomb et le zinc) est saisonnièrement plus élevée en raison de l'érosion des sols minéralisés en période de hautes eaux.

Répartition de l'eau au Yukon, 1993

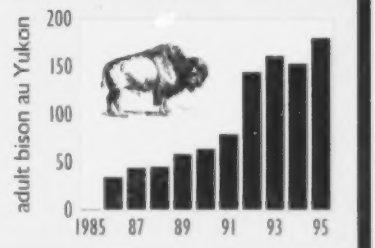


- Les activités minières pratiquées dans le centre du Yukon altèrent la qualité de l'eau. Ainsi, l'exploitation des mines métalliques a pour effet majeur d'accroître les concentrations de métaux, et notamment du zinc, dans les cours d'eau situés en aval de certaines mines.
- Une étude effectuée en 1993 révèle que la plupart des réserves en eau des collectivités yukonnaises sont conformes aux recommandations sur l'eau potable. Parfois, les concentrations de certaines substances comme le fer et le manganèse étaient plus élevées que celles recommandées. Ces substances sont présentes à l'état naturel et altèrent le goût et la couleur de l'eau, sans toutefois nuire à la santé humaine.
- La contamination par les bactéries, *Giardia* et d'autres pathogènes constitue la principale préoccupation en matière d'eau potable au Yukon. Santé Canada recommande de faire bouillir l'eau de boisson prélevée dans les lacs ou les cours d'eau. Les échantillons d'eau potable prélevés dans les collectivités dotées de bassins de stockage ou de puits privés sont plus susceptibles de contenir des bactéries que ceux prélevés dans les collectivités desservies par des réseaux d'adduction d'eau.
- Les bactéries contenues dans les effluents d'eau d'égout de Whitehorse persistent dans les cours d'eau d'aval jusqu'au lac Laberge. La situation devrait s'améliorer lorsque la nouvelle station de traitement des eaux usées sera en exploitation.

Les habitats et la diversité biologique

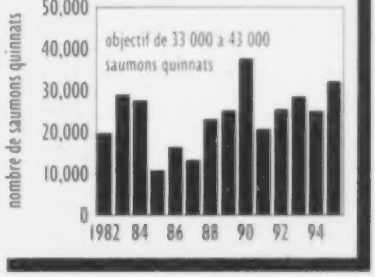
- L'expansion du réseau routier au Yukon au cours des cinquante dernières années a entraîné la fragmentation des habitats fauniques.
- Les habitats et la migration du poisson ont été modifiés par la construction de cinq barrages hydro-électriques : Lewes River (1899), North Klondike (1911), Mayo (1954), Whitehorse Rapids (1957) et Aishihik Lake (1975). Les études révèlent que la reproduction du corégone a été faible dans le lac Aishihik durant certaines années qui ont suivi la construction du barrage, et la fluctuation des niveaux d'eau a eu des effets sur les milieux humides. Des échelles à poisson ont été installées sur les barrages Lewes et Whitehorse, et une écloserie à saumons est exploitée à Whitehorse.
- L'exploitation des placers est une autre activité majeure qui influe sur l'habitat du poisson. Les nouvelles normes réduisent la quantité de sédiments permise dans les effluents des mines et exigent la remise en état de l'habitat du poisson.
- Rares sont les espèces menacées d'extinction au Yukon; la biodiversité est généralement importante.
- Une trentaine d'espèces végétales sont exclusives au Yukon ou au Yukon et à la partie contiguë de l'Alaska. Elles ont survécu à l'Âge glaciaire dans les régions non englacées.
- Deux espèces animales, soit la baleine boréale et le faucon pèlerin (*Anatum*), sont classées parmi les espèces en danger de disparition par le Comité sur le statut des espèces menacées de disparition au Canada. Le bison des bois est une espèce menacée. Les espèces considérées comme vulnérables sont le corégone du Squanga, la chouette cendrée, le hibou des marais, le cygne trompette, le faucon pèlerin (toundra), le carcajou, le grizzli et l'ours blanc.

Réintroduction du bison des bois



- Le bison est disparu du Yukon depuis des centaines d'années. Un troupeau de 34 bisons a été introduit en 1985 et s'est bien établi.
- La population de baleines boréales a chuté considérablement dans l'ouest de l'Arctique à la fin du XIX^{e} siècle, mais elle s'est rétablie au cours des dernières années. Celle de la mer de Beaufort est la plus nombreuse.
- De 1970 à 1978, les effectifs du faucon pèlerin ne comptaient que quelques individus. La mise en oeuvre d'un plan national de rétablissement et la réduction des émissions de DDT ont permis à l'espèce de se rétablir; on compte actuellement plus d'une centaine de couples reproducteurs dans tout le territoire.

Échappée de saumons quinnats
Axe fluvial du Yukon au Canada

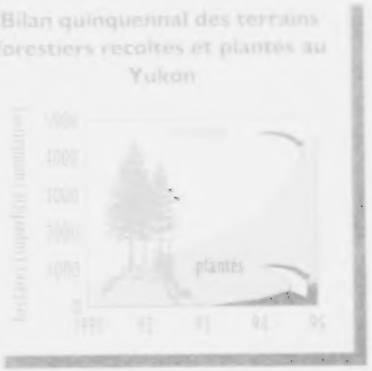


Les populations animales

- Les stocks de saumon kéta du fleuve Yukon ont généralement diminué. Les effectifs annuels de saumons frayant dans la rivière Fishing sont passés de 350 000 individus au début des années 1970 à 60 000 individus tout au plus dans les années 1980 et

Les milieux humides

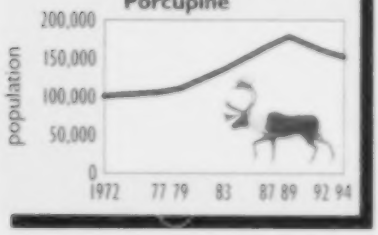
Les forêts



1990. Les stocks de saumon rouge de la rivière Alsek sont à des niveaux moyens et sont stable. Les stocks de saumon quinnat dans le fleuve Yukon et la rivière Alsek sont inférieurs aux niveaux cibles établis à l'échelle internationale, mais ils ne sont pas en baisse.

- Dans certains lacs, la surpêche a épuisé les stocks de touladi. Les mesures prises pour favoriser le rétablissement de la population comprennent la réduction de la pêche commerciale et la diminution des prises autorisées de pêche sportive.
- Il y a deux grandes hardes de caribous de Grant au Yukon : celle de la Porcupine et celle de la Fortymile. Les Gwitch'in, les Inuvialuit et les Inupiat de 13 collectivités de l'Alaska, du Yukon et des Territoires du Nord-Ouest sont tributaires de la harde de la Porcupine pour leur subsistance. Les femelles mettent habituellement bas dans le refuge national de faune de l'Arctique en Alaska; la harde est vulnérable aux activités d'exploitation gazière et pétrolière pratiquées dans le refuge.

Harde de caribous de la Porcupine



- La harde de caribous de la Fortymile, qui comptait des centaines de milliers de bêtes au début du siècle, ne compte plus que 20 000 individus en 1995. En Alaska surtout, elle a fait l'objet d'une exploitation excessive et non soutenable. Un groupe de travail international examine le problème.
- Au total, les 22 hardes de caribous des bois comptent de 30 000 à 35 000 têtes. En 1994, trois hardes (Carcross, Aishihik et Chisana) étaient en baisse et trois autres (Tay River, Finlayson et Wolf Lake) étaient en hausse.
- La population d'orignal du Yukon est stable à près de 60 000 bêtes. Elle a diminué dans les régions d'Aishihik et de Carcross depuis 1980, tandis qu'elle a augmenté dans la région de Nisutlin durant les années 1980.
- Il y a environ 4 500 loups au Yukon. Un programme de conservation des espèces sauvages visant à contrer le déclin des populations de caribous et d'orignaux dans la région d'Aishihik-Kluane comprenait la mise en oeuvre d'une campagne d'extermination des loups en 1993, afin de réduire la menace que ce prédateur représente pour ces ongulés.
- On compte entre 6 000 et 7 000 grizzlis et 10 000 ours noirs au Yukon. Les grizzlis sont considérés comme vulnérables partout dans le monde, mais les populations du Yukon sont stables.

Les milieux humides

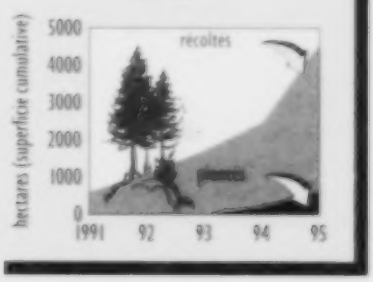
- Peu de milieux humides d'importance ont été détruits. Quatre zones humides sont protégées dans le cadre du règlement des revendications territoriales depuis 1984. Certains des milieux humides de plus petite taille, surtout dans le sud du Yukon, sont menacés par la construction résidentielle et par l'agriculture.
- Environ 300 000 canards en moyenne nichent dans la plaine Old Crow (zone humide d'importance internationale). Cet habitat de nidification est particulièrement important lorsque la sécheresse sévit dans les Prairies.
- Trente-quatre espèces de cygnes, d'oies, de bernaches et de canards séjournent au Yukon pendant une partie de leur cycle annuel.

Roitelet à couronne dorée, habitant de vieilles forêts

Les forêts

- Les forêts occupent près de 60 p. 100 de la superficie totale des terres du Yukon et représentent jusqu'à 5 p. 100 de la superficie forestière totale du Canada.
- Les communautés végétales sont adaptées aux feux de forêt. En moyenne, une superficie donnée de la forêt brûle tous les 80 à 200 ans au Yukon. Certains oiseaux et certaines espèces fauniques, comme la martre, le caribou des bois et le roitelet à couronne dorée, ont associés aux vieux peuplements.
- Les principales activités de récolte de bois au Yukon ont commencé pendant la ruée vers l'or. En 1900, 233 000 mètres cubes de bois ont été utilisés au Yukon. La récolte a culminé en 1994-1995 à 419 211 mètres cubes. La région forestière de Watson Lake a fourni 86 p. 100 de cette récolte.
- L'augmentation récente de la demande du bois d'oeuvre au Yukon a mis en lumière le besoin d'améliorer la politique et les pratiques d'aménagement forestier. Le Yukon a lancé son premier programme de reboisement en 1992.

Bilan quinquennal des terrains forestiers récoltés et plantés au Yukon



Acknowledgements

Co-ordinators: Joan Eamer (Environment Canada), Yvonne Harris (Yukon Department of Renewable Resources).

Steering Committee

Federal Government: Keith Bebak, Anne Hargraves, Ann Purdy, (Renewable Resources, DIAND); Marg Crombie (Environment Directorate, DIAND); Roger Horner (Land Resources, DIAND); Bill Slater (Water Resources, DIAND); Scott Smith (Agriculture Canada); Lynn Stewart (Canadian Parks Service); Al von Finster (Fisheries and Oceans Canada); Vic Bartnik, Donald Bernard, Harry Hirvonen, Don Russell (Environment Canada).

First Nations: Fran Byers (Liard First Nation); Timothy Cant (Kluane First Nation); Carl Charlie (Vuntut Gwitchin First Nation); Teddy Charlie (Selkirk First Nation); Robert Lee Jackson (Teslin Tlingit Council); Lawrence Joe (Champagne and Aishihik First Nations); Ed Kormendy (Tr'ondek Hwech'in First Nation); Johnny Sam (Carmacks Little Salmon First Nation); Ted Staffen (White River First Nation); Norma Kassi, Ray Quock (Council of Yukon First Nations).

Non-government Organizations: Monty Alford (Canadian Polar Commission), Debbie Gohl (F.H. Collins High School), Tanya Handley (Yukon Conservation Society), Janne Hicklin (Northern Environmental Network), Dawn Lammers (Raven Recycling), Rob McIntyre (Yukon Chamber of Mines), Duane Morgan (Yukon Chamber of Commerce), Ted Osmond-Jones (Yukon College), Juri Peepre (Canadian Parks and Wilderness Soc.), Sabine Schweiger (City of Whitehorse), Russ Tait (Yukon Fish and Game Association), Mary Tooley (Yukon Chamber of Commerce).

Yukon Government: Perry Diamond, Beth Hawkings, Manfred Hoefs, Val Loewen, Jillian Lynn Lawson, John Meikle, Pat Paslawski (Renewable Resources); Ron Pearson (Health and Social Services); Christina Pekarik (Economic Development); Florian Vedress (Community and Transportation Services).

Yukon Council on the Economy and Environment

Reviewers and Contributors

Federal Government: Debra Wortley (Canadian Forest Service); Karyne Besso, Mike Burke, Bruce Chambers, Peter Henry, Richard Janowicz, Dave Latoski, Mark Palmer, Pat Roach, Leo van Kalsbeek, Don White, Gerry Whitley (Department of Indian Affairs and Northern Development); Vic Enns, Lee Harding, Jim Hawkings, Nancy Hughes, Ken Little, George Mackenzie-Grieve, Wendy Nixon, Michael Purves, Eric Taylor, Bruce Thomson (Environment Canada); Ian Boyce, Sandy Johnston, Pat Milligan (Fisheries and Oceans).

Yukon Government: Joe MacGillivray (Bureau of Statistics); Greg Kent, Robin Walsh, Bob Gates, Gerry Gerein (Community and Transportation Services); Skeeter Verlaine-Wright (Executive Council Office); Jim Connell, Nick de Graff, Rick Farnell, Harvey Jessup, Catherine Kennedy, Doug Larsen, Ben Moise, Dave Mossop, David Murray, Jody Shimkus, Susan Thompson, Jenny Trapnell, Rick Ward (Renewable Resources); Ruth Gotthardt, Catherine Paish, John Spicer (Tourism).

Others: Gary McRobb (Friends of Aishihik Lake); William Byers, John Maissan (Yukon Energy Corporation).

Elders

Roddy Blackjack, (Carmacks Little Salmon First Nation); Stella Boss, Moose Jackson, Stella Jim, Paddy Jim, Margaret Johnson (Champagne and Aishihik First Nations); Dick Dickson, Joe Johnson (Kluane First Nation); Johnny Smith (Kwanlin Dun First Nation); Bob Watson (Liard First Nation); Charlie Dick (Ross River Dena Council); Henry Broeren, Annie Geddes (Ta'an Kwach'an First Nation); Johnny Baker (Tagish First Nation); Gladys Johnson, Martha Van Heel (Teslin Tlingit Council); Rowena Flynn (Trondek Hwech'in First Nation); Effie Linklater (Vuntut Gwitchin First Nation); Billy Blair (White River First Nation); Ron Morberg (Yukon Elders Council); Elders Documentation Project (Council of Yukon First Nations).

Consultants

Cracker Creek Productions, Cryo Geographic Consulting, ESSA Technologies Ltd., Aaron Foos, David Hedmann and Associates, Helen Jeong, Laberge Environmental Services, Midnight Arts, Mougeot Geoanalysis, Olsen and Olsen Resources, Polar Geomatics Inc., W.R. Ricks Consulting, RumKee Productions, W.L. Staples Consulting, Nancy D. Steffen, Topham Creek Services, Trans Northern Resource Management Consulting, S.P. Withers.

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Aasman Design (cover), Joan Eamer (desktop publishing), Geological Drafting Services (maps), Green Apple Graphics (chapter 6), Hemlock Printers (printing), Horizon Graphics (first draft), Midnight Arts (timeline).

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Introduction

The Yukon State of the Environment Report provides the first big picture of the Yukon environment. It also presents a portrait of who we are, our environment, how we use it, the impact we have on it, and how changing it could affect us. With this picture, we can make the choices necessary for a healthy environment and a healthy economy, now and in the future.

By North American or European standards, the Yukon environment is pristine. Situated in the northwest corner of Canada, the territory is dominated by wilderness, its population of about 31,000 concentrated in a combined area representing less than two per cent of its land base. The quality and wealth of this environment have sustained Yukon First Nations for generations and attracted many others to seek their fortunes or build their lives here. Others travel from the ends of the earth to experience the diversity and abundance of the Yukon's fish and wildlife, the purity of its air and water, and the splendour of its landscapes.

But the Yukon environment is not untouched by humans and development. The territory's economy, and the well-being of the people who live here, depend heavily on the land's natural resources. These resources are used, consumed, and otherwise affected by human activity. In addition, the Yukon environment is susceptible to changes induced by human activities occurring half the world away; for example, climate warming caused by high global rates of fossil fuel use, and the long-range transport of pesticides and industrial chemicals affect the Yukon environment.

Whether for a sense of security about the safety of drinking water, confidence in the continued availability of natural resources, or comfort in the protection of critical habitats, people of diverse backgrounds and interests need to know about the state of our environment.

I want to leave something for them to enjoy, our future generation. My grandchildren I'm talking about. I want them to follow; I want them to know where they're coming from, you know. I don't want to see them a lost person in their own country in Yukon.

I like to see we get together and start to co-operate, work together on it for your children and my children, grandchildren. That's what I'm talking about.

Roddy Blackjack, Carmacks
Little Salmon First Nation Elder

The Purpose of the Yukon State of the Environment Report

State of the environment reporting in Canada began with the publication of the first national report in 1986. The Yukon report responds to a broad public interest in the health of the territory's environment. The same interest prompted passage of the Yukon Environment Act, which requires a state of the environment report every three years, beginning in 1995, along with interim reports.

This report is to be used as a tool when making decisions about the environment and the way we want to live. It presents background information and a snapshot of the state of the environment and human activities and provides a regional and global context for assessing significance. The report identifies, where possible, the extent of impacts and presents a baseline for the assessment of future activities.

Preparing the Report

The Yukon State of the Environment Report was prepared to answer four questions:

- What is happening in the environment?
- Why is it happening?
- Why is it significant?
- What are we doing about it?

The information needed to answer these questions was gathered from many sources – government agencies, non-government groups, management boards set up through land claims agreements, and First Nation elders. Evolving scientific knowledge of the north has recently converged with First Nations' traditional ecological knowledge, anchored in generations of first-hand observations of wildlife and experience on the land, to enhance our understanding of the Yukon environment. Continuing collaboration and consultation among research scientists, Yukon First Nations and other resource users will enhance a rich and growing information base.

When I was small, my grandmother used to put a chair down the bank, tell us to stay there, not to go anywhere. There be caribous all over. And they were just going for weeks sometime, crossing. And you don't see that anymore. [at Twelve Mile, on the Yukon River downstream of Dawson City]

Rowena Flynn, Trondik Hwech'in First Nation Elder

Ecological Perspectives

The state of the Yukon environment is described from several perspectives. From the British Columbia border to the Beaufort Sea, the Yukon environment is a web of components and regions. To focus on one component or one region distorts the larger picture and ignores the vital interconnections that make up our specific environment.

The Yukon is composed of 23 ecoregions, all of which have significant distinguishing biological and physical characteristics based on such features as vegetation types, topography and climate. The Yukon State of the Environment Report combines these ecoregions into five reporting units and begins the work of building a picture of environmental well-being for each of them.

We are now forced to accustom ourselves to an accelerating ecological interdependence among nations. Ecology and economy are becoming ever more interwoven – locally, regionally, nationally and globally – into a seamless net of causes and effects.

World Commission on Environment and Development, Our Common Future (the 'Brundtland Report')

An ecosystem approach establishes the links among various physical elements in nature. This perspective helps us understand how changes in one part of the system may lead to alteration in another part; for example, how fish and wildlife may be affected by changes in climate. Viewing the environment as a system, subject to natural cause and effect, is important in understanding how human activities can alter it.

Albert Einstein said that "the environment is everything which is not me". In contrast, First Nations and other peoples have for hundreds of years defined themselves through their relationship to their environment and the wildlife they share it with. For them, humans are a significant and inseparable part of the environment. They are part of the land and part of the water.

An ecological view of the environment recognizes the interdependence between our society, our economy and the ecosystem within which we live – and how changes to any element can affect the other two. It acknowledges the environmental consequences of our activities and the impact of the environment on them. For these reasons, a portrait of the state of the environment includes information on human activities that use and affect the environment.

Our Society and the Environment

How we live and where we live affects the Yukon environment. Generally, environmental effects from people are greatest where they and their activities are most concentrated. Almost 75 per cent of Yukoners live

in the vicinity of Whitehorse. The remaining 25 per cent live in 15 other communities and rural areas. All the communities, except Old Crow, are linked by highway. The population distribution and road network have a profound effect on the Yukon's development, how resources are used, the demands placed upon them, and their effect on the environment.

Our knowledge, values and culture also shape our view of the environment. The Yukon First Nations' unique relationship with the environment is recognized in the Yukon Umbrella Final Agreement. Signed into law in February 1995, the agreement gives the 7,400 beneficiaries (about 25 per cent of the Yukon population) a significant voice in managing the territory's environment.

Compared to many other regions of Canada, the Yukon's population is young. Almost 50 per cent of the population is under 30 years of age; more than half of that group under 15 years. That youthfulness is a good reason for the wise management of the territory's environment to ensure a sustainable future for young Yukoners who choose to live, work and raise a family here.

My great grandpa he talk to me, he talk to me before he die. He tell me to use it, to tell that story to other kids and pass it around.

Grandpa have to tell you a story for everything – how to hunt, where a lot of berries is in summer time, where is good place for moose.

Don't throw anything in the water, Grandpa say. You burn it or do something. You don't cut trees down for nothing.

Long time ago, us, we take care of our land good. We take care of it good.

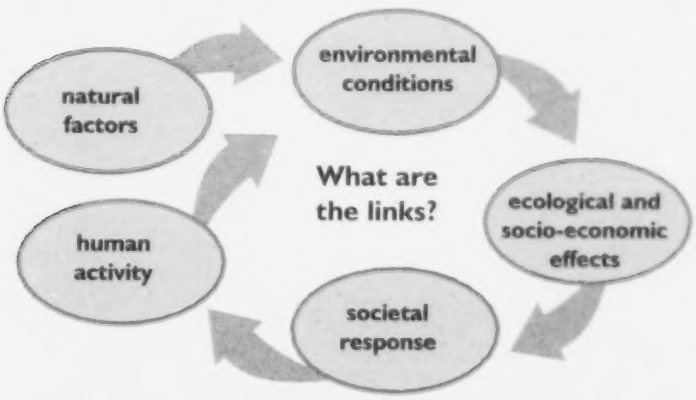
Charlie Dick, Ross River Dena Elder

Our Economy and the Environment

The Yukon economy is largely a service economy, with service-producing industries accounting for 75 per cent of the Gross Domestic Product (GDP), and goods-producing industries making up 25 per cent of the GDP in 1994. The Yukon economy relies on government spending and cyclical resource industries such as mining and forestry, as well as tourism. The resource sector is subject to major fluctuations reflected in the economy as a whole. For instance, mining and related services accounted for less than eight per cent of the GDP in 1994, but two years earlier, the contribution was 26 per cent. Renewable resource industries, including agriculture, fishing, trapping and logging, accounted for less than one per cent of the 1994 GDP, while government services accounted for 30 per cent.

Non-wage activities contribute to the well-being of individuals and the fabric of communities in the Yukon. The country food harvest, volunteer work and housework are all non-wage activities that are not represented in economic indicators like the GDP. Studies in the Yukon show that the country food harvest makes up 27 to 60 per cent of the community food basket in Ross River, Old Crow and Teslin.

Tourism (especially wilderness tourism), commercial fishing, trapping and hunting, as well as many non-wage activities, need healthy



So that's how we used to never run out of our animals: we see them, but we leave them there, we don't bother them. Not even much as to scare them off. And if we do need it and we go get it. That's how we used to look after our land.

Martha Van Heel, Teslin Tlingit Elder

ecosystems that include thriving wildlife and fish populations. Many Yukoners, either through the market or non-wage economy, depend on healthy ecosystems for their livelihood and culture. Some economic sectors, such as forestry and mining, however, do not directly benefit from conserving all components of ecosystems. Sometimes one industry's bread and butter can limit another industry. Integrating decision-making on the economy and the environment in the Yukon involves meeting the needs of livelihood, the preservation of cultures and the protection of ecosystems.

Sustainability and the Future

State of the environment reporting gives all Yukoners a way to contribute to a collective understanding of their environment. It provides information to help them make choices that will build a sustainable economy and conserve a healthy environment. The Yukon State of the Environment Report is a step towards a comprehensive picture of the Yukon environment from a broad ecological perspective. The picture is not complete. Annual updates will add detail, fill in the gaps and monitor changes in critical areas. The Yukon's first State of the Environment Report establishes a benchmark we can use to evaluate our performance, determine what environmental conditions have improved or deteriorated and identify what efforts are required to reverse disturbing trends.

Yukon Environment Act

Yukon State of the Environment Report

47. (1) The Government of the Yukon shall report publicly on the state of the environment pursuant to this Act.
(2) The purpose of a report under subsection (1) is
(a) to provide early warning and analysis of potential problems for the environment;
(b) to allow the public to monitor progress toward the achievement of the objectives of this Act; and
(c) to provide baseline information for environmental planning, assessment and regulation.

Requirements for the Yukon State of the Environment Report

48. (1) The Minister shall prepare and submit to the Legislative Assembly a Yukon State of the Environment Report within three years of the date this section comes into force and thereafter within three years of the date of the previous report.
(2) The Yukon State of the Environment Report shall
(a) present baseline information on the environment;
(b) incorporate the traditional knowledge of Yukon First Nation members as it relates to the environment;
(c) establish indicators of impairment of or improvement to the environment and identify and present analyses of trends or changes in the indicators; and
(d) identify emerging problems for the environment, especially those involving long-term and cumulative effects.
(3) The Minister shall coordinate preparation of a Yukon State of the Environment Report with the preparation of a revision of the Yukon Conservation Strategy and, to the extent practicable, with state of the environment reporting of the Government of Canada, circumpolar nations, and jurisdictions adjoining the Yukon, and an audit under section 39.

Review by Council

49. The Council shall review a Yukon State of the Environment Report and submit a report of its review to the Legislative Assembly.

Interim Report

50. (1) Commencing from the date of the first Yukon State of the Environment Report, for every period of twelve consecutive months in which a Yukon State of the Environment Report is not made, the Minister shall prepare an interim report and submit it to the Legislative Assembly.
(2) An interim report under subsection (1) shall comment on matters contained in the previous Yukon State of the Environment Report.

Chapter 1 Air

Change in climate and atmospheric conditions is not new. Over hundreds of millions of years the Earth's atmosphere has been modified by contaminants from natural events such as forest fires and volcanic eruptions. Because the Earth's orbit and the tilt of its axis shift periodically, the distribution of solar energy reaching the Earth shifts gradually over thousands of years. Evidence from fossils and from the polar ice caps tells us that changes in global climate have taken place slowly but routinely over the history of our planet.

Scientific evidence also tells us that since the beginning of the industrial age, and for the first time in the planet's history, human beings are causing direct changes to the Earth's atmosphere by emitting large quantities of air pollutants. This may lead to more abrupt changes in climate, air quality and levels of ultraviolet radiation than have ever occurred before.

Many gases released at the Earth's surface accumulate in the atmosphere. Some pollutants alter the Earth's climate; some make the upper atmosphere less effective as a filter to screen harmful ultraviolet rays; some pollutants travel hundreds or thousands of kilometres through the atmosphere with the winds and then return to the Earth's surface in rain, snow or dust particles; other pollutants alter air quality on a regional or local scale. This chapter discusses, in a Yukon context, three major global-scale atmospheric issues: climate change, depletion of the ozone layer, and long-range transport of atmospheric pollutants. Yukon air quality is discussed in the last section of this chapter and in the section on the Whitehorse urban area.

1.1 Climate and the Greenhouse Effect

We live in a natural greenhouse. The Earth's atmosphere contains small amounts of gases that trap the sun's heat to warm the land, air and water. The average temperature of the Earth's surface is 15°C – but without the natural greenhouse effect, the average temperature would be a chilly -18°C.

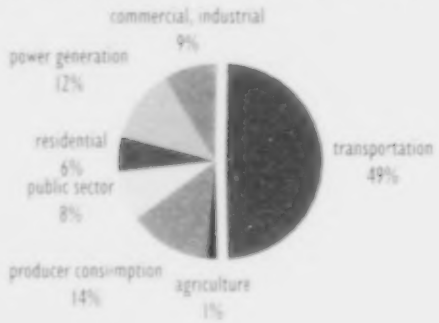
The main greenhouse gases – water vapour, carbon dioxide, methane and nitrous oxide – all occur naturally. Many human activities, especially those which produce and burn fossil fuels, contribute more of these gases to our atmosphere. A few human-made chemicals, such as CFCs (chlorofluorocarbons), are also potent greenhouse gases.

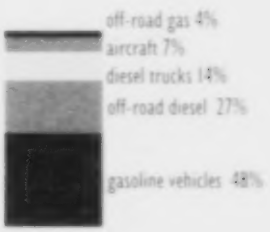
The main greenhouse gas worldwide, other than water vapour, is carbon dioxide. Canadian per capita carbon dioxide emissions ranked third highest in the world in 1990, exceeded only by the United States and the former East Germany. Sources of carbon dioxide from burning of fossil fuels in the Yukon are shown in Figure 1.1. The Yukon's per capita emissions of carbon dioxide from fossil fuels were 11 per cent below the national average in 1993. Wood burning is, however, more prevalent in the Yukon than in most of Canada (see Section 6.4) and emissions from wood burning are not included in this calculation.

... a chronology of the Yukon environment.

Figure 1.1
Yukon emissions of carbon dioxide from the burning of fossil fuels, 1993

Total emissions were estimated at 440 kilotonnes. This does not include carbon dioxide emissions from wood heating or from natural sources. Carbon dioxide in the upper atmosphere contributes to the greenhouse effect and global warming. Emission estimates are from records of fuel use.





In addition to these direct releases of gases, human activities can have complex indirect effects on greenhouse gas levels. For example, logging, forest fires and the clearing of land for agriculture increase atmospheric greenhouse gas levels by releasing carbon stored in plants and soils and by reducing the capacity of the land to absorb carbon (see Section 5.2).

A United Nations panel of scientists has estimated that the atmospheric concentration of carbon dioxide in 1991 represents an increase of about 27 per cent over the pre-industrial level, with a current rate of increase of about 0.6 per cent of the pre-industrial level per year.[1] Concentrations of other greenhouse gases are also rising. But is the Earth getting warmer? Since the 1890s, global temperatures have shown an upward trend. Since 1854, the 11 warmest years on a worldwide basis have been 1944, 1973, 1980, 1981, 1983, 1986, 1987, 1988, 1989, 1990 and 1991.[2]

Climate data have been analysed on a regional basis in Canada. The longest and most representative sets of records were combined to develop regional averages (Figure 1.2).[3] The records for the Yukon/North BC Mountains region show a statistically significant increase in the annual average temperature of about 0.8°C from 1901 to 1993.[3] This warming trend does not apply to all seasons. Winters in the Yukon/North BC Mountains region are influenced by Arctic and Maritime air masses and average temperatures fluctuate widely. The records show no significant trend in average winter temperatures.

Everyone has an opinion on how the weather has changed. Long-time Yukon residents often remark that winters do not get as cold as they used to. Perceptions of how cold a winter has been are probably influenced more by weather extremes than by averages. To test this, numbers of very cold days were counted for each year at the four Yukon weather stations with the most reliable long-term data. Records for Whitehorse (since 1943), Watson Lake (since 1940), Mayo (since 1926) and Dawson City (since 1901) showed

50,000 -10,000 B.P. CREATION OF THE LAND

The Wisconsin Ice Age: Expect Cold and Dry Conditions for 40,000 Years

During the ice age, average temperatures were about 3 to 6° C cooler than present temperatures. Lands on the edge of the glaciers, like the northern and central Yukon, were grassy tundra.

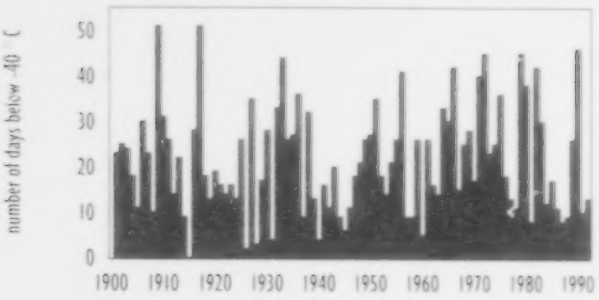
Beringia: A Place To Get Away From it All

Lower sea levels exposed a land bridge between Siberia and Alaska. Fish, birds, animals and insects migrated back and forth across this bridge into the ice-free area of the Yukon known as eastern Beringia.

similar patterns of year-to-year variation in numbers of very cold days, with no warming trends at any location (Figure 1.3).

Summer temperatures are less variable and have significantly increased since the turn of the century (Figure 1.2). The length and warmth of the growing season affect agriculture and the distribution of natural vegetation (see Section 5.2). An Agriculture Canada study of trends in climate variables important to agriculture looked at 100 years of weather records from six sites in southern Canada.[3] Analyses showed that the growing season has become longer and warmer at stations in western Canada, but not at stations in eastern Canada. An analysis of weather records from Mayo done for this report indicated that, although the length and the timing of the growing season has not changed since the 1920s, the growing season at Mayo has become warmer (Figure 1.4).

Figure 1.3
Very cold days at Dawson City



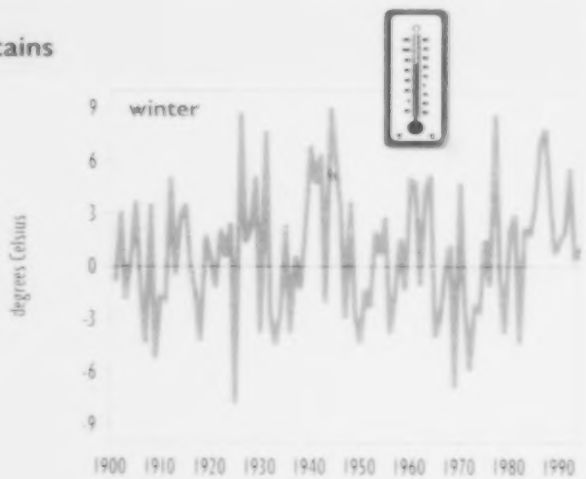
The Dawson City temperature records from 1901-1992 show no clear trend in numbers of very cold days.

It is too early to tell if these observed changes in temperature are a result of increased greenhouse gases. Climate is influenced by many factors, including short-term and long-term natural changes in ocean currents and air circulation patterns.

General circulation models based on atmospheric physics and interactions between the atmosphere and the sea and land have been developed in an attempt to predict the kinds of climate change that could be expected in the future. Based on these models, scientists predict that the climate in northern Canada will be more affected by increases in greenhouse

Figure 1.2
Temperature trends, Yukon/North B.C. Mountains

Average summer temperatures show a statistically significant increase since the beginning of the century. Winter temperatures are much more variable and show no clear long term trend, although the past 12 years have all been close to or above the average. Data points are departures of average temperatures from the 1951-1980 average.



CREATION OF THE LAND — 25,000 -12,000 B.P.

Humans Expand into the Yukon

Human beings migrated across the land bridge following animal herds and entered the Yukon about 24,000 years ago.

Figure 1.1
Yukon emissions of carbon dioxide from the burning of fossil fuels, 1993

Total emissions were estimated at 440 kilotonnes. This does not include carbon dioxide emissions from wood heating or from natural sources. Carbon dioxide in the upper atmosphere contributes to the greenhouse effect and global warming. Emission estimates are from records of fuel use.

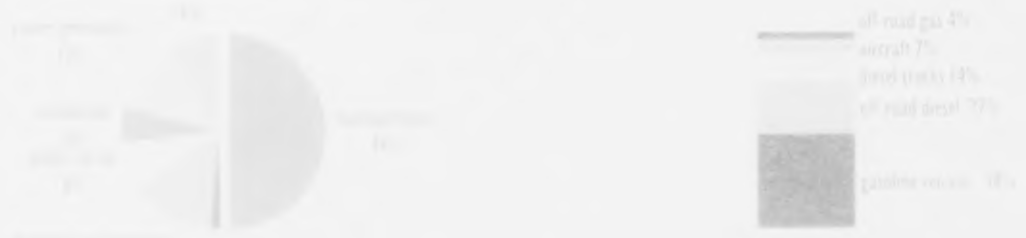


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Figure 1.3
Very cold days at Dawson City

The Dawson City temperature records from 1901–1992 show no clear trend in numbers of very cold days

It is not easily to tell if these observed changes in temperature are a result of increased greenhouse gases. Climate is influenced by many factors including short-term and long-term natural changes in ocean currents and air circulation patterns.

General circulation models based on atmospheric physics and interactions between the atmosphere and the sea and land have been developed in an attempt to predict the kinds of climate change that could be expected in the future. Based on these models scientists predict that the climate in northern Canada will be most affected by increases in greenhouse

Figure 1.2
Temperature trends, Yukon North B.C. Mountains

Average summer temperatures show a statistically significant increase since the beginning of the century. Winter temperatures are much more variable and show no clear long-term trend, although the past 12 years have all been close to or above the average. Data points are departures of average temperatures from the 1951–1980 average.

25,000 -12,000 B.P.

Humans Expand into the Yukon

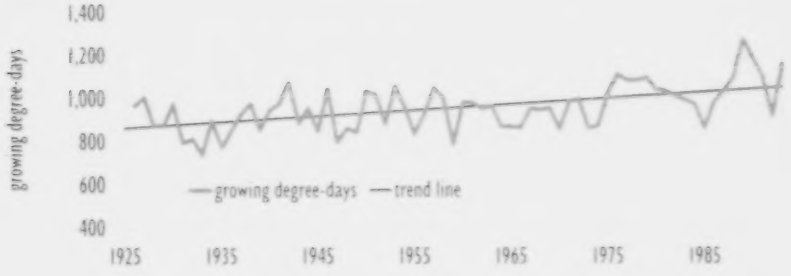
Human beings migrated across the land bridge following animal herds and entered the Yukon about 24,000 years ago.

gases than will the climate in southern Canada. The models also predict a greater degree of warming in the winter than in the summer for the North, and an increase in precipitation. A recent study by Agriculture Canada showed that land suitable for agriculture in the Yukon could expand significantly if current carbon dioxide levels double.[6]

One of the many effects of a warming climate is the melting of permafrost. Monitoring of permafrost along the Mackenzie Highway in the Northwest Territories showed that the southern limit of discontinuous permafrost moved northward by about 120 km between 1962 and 1988.[7]

Figure 1.4
Total warmth of the growing season in Mayo, 1926-1993

The amount of heat available for plant growth in Mayo has increased since 1926. This trend is statistically significant. Growing season warmth is measured in 'growing degree-days'. These are not days, but rather a cumulative measure of how warm the days are during the growing season (the calculation is based on the number of degrees above 5° C for each day's average temperature.) For reference, Abbotsford, in southern B.C., has about 2,000 growing degree-days each year.



Controlling Greenhouse Gases

The global problem of greenhouse gas emissions requires global solutions. In 1992, nations meeting at the Rio Earth Summit agreed to adopt measures to stabilize levels of emissions of greenhouse gases at 1990 levels by the year 2000. In the spring of 1995 a follow-up meeting was held in Berlin. Attempts by some countries to set targets for greater reductions of emissions of greenhouse gases were not successful. However, the targets agreed to at the Rio Earth Summit were reaffirmed and a process for evaluating and strengthening measures to control greenhouse gases was initiated.

Achieving Canadian targets requires cooperation from the provinces, territories and the private sector. Individual Canadians are directly responsible for 25 per cent of the country's emissions. Much of the action required is at the individual level – action such as improving the energy efficiency of homes and reducing the use of private vehicles.[8]

'Air Global' and Greenhouse Gas Control

Setting and reaching greenhouse gas reduction targets on a global scale will require a level of cooperation that the world has not yet achieved. An example is the control of emissions from aircraft. Air traffic is the world's fastest growing source of carbon dioxide emissions, with airplanes accounting for an estimated five per cent of the greenhouse effect from burning fossil fuels and with air traffic expected to double in the next 15 years. However, international flights are not included in agreements on targets for reductions of emissions. This is because of the difficulty of working out which country is responsible for what emission.[9]

CREATION OF THE LAND

Game Mother Brings Animals into the World

From her swing strung between the mountains around Bennett Lake, Game Mother sends moose, caribou, sheep, rabbit and wolf into the world.

Discovery of a Hole in the Antarctic Ozone Layer

In 1984 scientists made a dramatic discovery: in the spring up to one-third of the ozone over Antarctica disappears. This could not have been predicted based on what was known about the chemistry of the atmosphere. It is now known that the frozen nitric acid crystals in the thin clouds that form every spring in the cold, stable air high over Antarctica are sites of rapid chemical reactions involving chlorine. The result of these reactions is the loss of ozone.

In 1994, data from NASA research satellites proved that the chlorine in these reactions comes from human-made chlorine compounds such as CFCs and not from natural sources such as volcanoes or sea spray.

Why There is NO Hole in the Arctic Ozone Layer

Concern over the Antarctic ozone hole led to research to see if the same thing was happening to the ozone over the Arctic. The research showed that, although chlorine concentrations are high enough to result in severe ozone depletion, the more complex air movement patterns in the northern atmosphere prevent the formation of the stable and very cold conditions needed to form clouds. Thus the rapid chemical reactions that occur in clouds over the Antarctic are not common in the Arctic and the rate of ozone depletion is slower.

Although there is no Arctic ozone hole, evidence points to a slow and steady loss of ozone in the northern hemisphere over the past decade.[1]

1.2 The Earth's Radiation Shield: Stratospheric Ozone

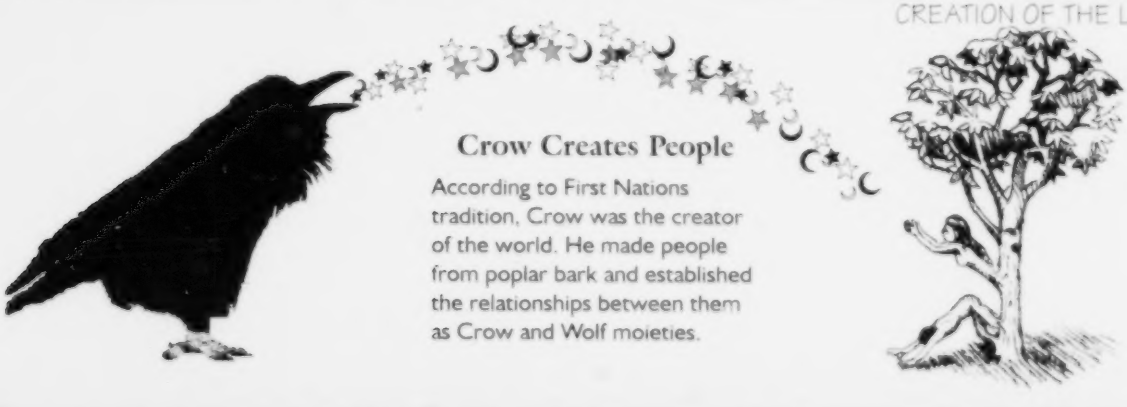
The Earth has its own natural shield that protects all life forms from the sun's damaging ultraviolet radiation. A small amount of ozone, a naturally occurring gas, is spread through a 20 kilometre-thick layer of the Earth's outer atmosphere, known as the stratosphere. If all the molecules of ozone in this layer were compressed at the Earth's surface, they would form a layer only slightly thicker than a Loonie. This fragile shield is now being depleted by synthetic chemicals released to the atmosphere through human activities.

Stratospheric ozone is measured from the ground at several sites in Canada. These ground measurements can be used to look at trends in the ozone layer thickness over the years. Ozone is also measured worldwide by a satellite operated by the United States. Satellite information is summarized as weekly averages over several years, and can be used to compare the thickness of the ozone layer at different locations and different seasons (Figure 1.5).

The closest ground-measuring site to the Yukon is at Edmonton, Alberta. Records from the Edmonton ozone monitoring station show a decline in stratospheric ozone thickness starting in the late 1970s. The thinning has occurred during the late winter and spring. Satellite ozone measurements show that during these seasons ozone thicknesses are at their highest in the Yukon. Because of the Yukon's high latitude, the angle of the sun is very low during the winter and spring. Consequently, any increase in the intensity of ultraviolet radiation reaching the Yukon due to ozone depletion has probably been small.

The most harmful component of ultraviolet radiation reaching the Earth's surface is referred to as UV-B radiation. UV-A radiation has also been linked to skin cancer. UV-A is not affected by ozone.

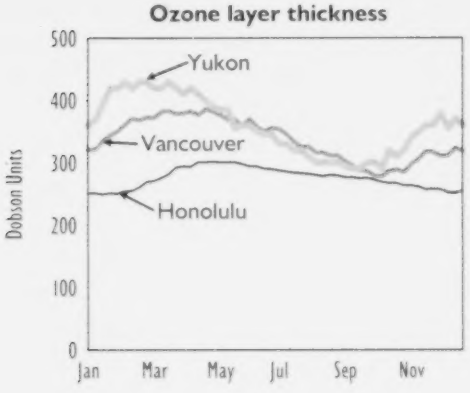
An index has been developed to help people make choices about their exposure to the sun. This



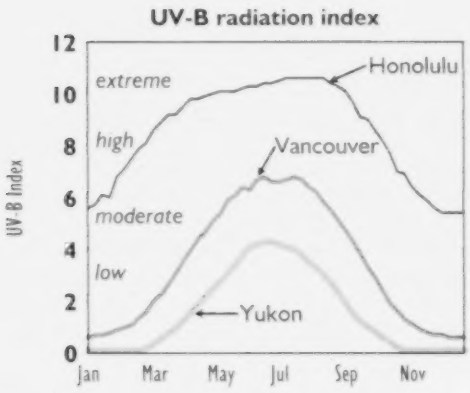
Crow Creates People

According to First Nations tradition, Crow was the creator of the world. He made people from poplar bark and established the relationships between them as Crow and Wolf moieties.

Figure 1.5
Average ozone layer thickness and UV-B index for Central Yukon, compared with Vancouver and Honolulu



The ozone layer thickness changes naturally over the course of each year. Points along each line represent the average thickness of the ozone layer for each week of the year, from 1978 to 1991, as measured by U.S. polar-orbitting satellite.



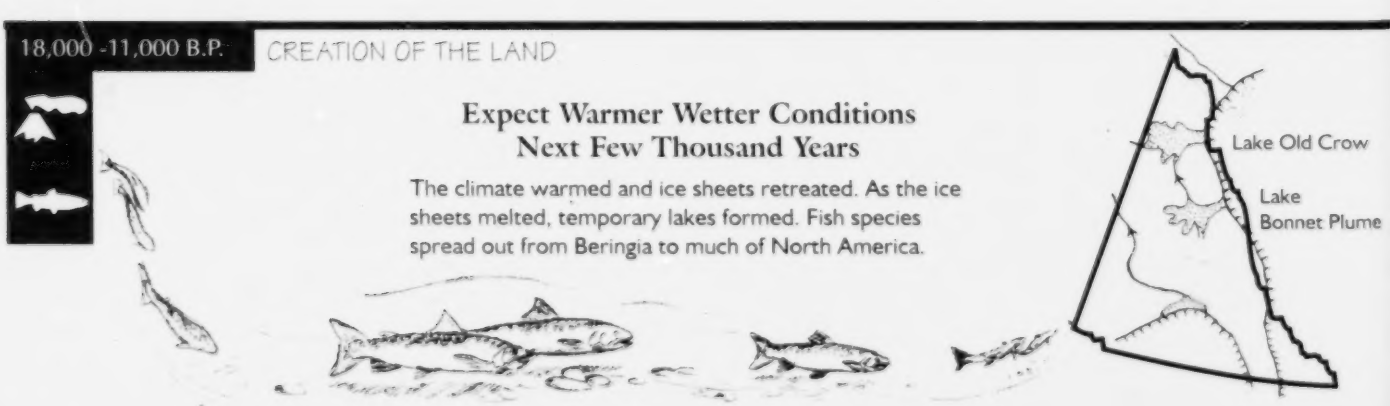
The higher the index, the greater the risk of exposure to UV-B radiation on sunny days. The UV-B index is calculated from the thickness of the ozone layer and the angle of the sun. The lower UV-B index for the Yukon is mainly due to the Yukon's higher latitude. Points along each line represent the average maximum UV-B index for each week of the year, from 1978 to 1991.

index rates the level of exposure to UV-B radiation at a particular time and place. The actual radiation reaching the ground may be much less than indicated by the index if the day is cloudy, or it may be higher in early spring due to reflection from the snow. Figure 1.5 shows that the Yukon, because of its relatively thick ozone layer and because of its high latitude, has UV-B index values in the low to low-moderate range.

The main factor controlling the UV-B exposure received by humans is their own behaviour. The increase in leisure activities (including winter holidays to regions with much higher UV-B radiation levels) has already resulted in higher exposure to UV-B radiation. Human exposure to increased UV-B levels can result in sunburn, premature skin aging, skin cancers, eye diseases and problems with the immune system. Using sunscreen, wearing hats and sunglasses, and minimizing time spent in intense sunlight can lower the risks.

Increasing amounts of UV-B radiation may also affect natural ecosystems and forestry, fisheries and agriculture. UV-B radiation reduces crop yields and affects the growth of algae in lakes and oceans. No research or monitoring directly related to UV-B radiation has been conducted in the Yukon.

Worldwide, CFCs are the main ozone-depleting substances released by human activities. Concentrations of CFCs, which are used mainly in foams, refrigeration and air conditioning, have increased steadily since the start of monitoring in 1977. The rate of increase has declined since 1989, when many countries began measures to reduce the release of CFCs following the Montreal Protocol. These levels can be expected to stabilize and then decline very slowly if international efforts to control ozone-depleting substances are successful.


18,000 -11,000 B.P.
CREATION OF THE LAND
Expect Warmer Wetter Conditions
Next Few Thousand Years
The climate warmed and ice sheets retreated. As the ice sheets melted, temporary lakes formed. Fish species spread out from Beringia to much of North America.
Lake Old Crow
Lake
Bonnet Plume

Canada was one of the first nations to sign the updated Montreal Protocol in 1992. This document commits Canada and other countries to phasing out the import and production of ozone-depleting substances. Regulations under the Canadian Environmental Protection Act have put Canada's commitment into effect. Halons, once used in fire extinguishers, were eliminated in new products in 1993. CFC production will be eliminated by the end of 1995. However, large quantities of these ozone-depleting substances remain in use. The Yukon government is developing regulations to control the reduction and disposal of ozone-depleting substances used or stored in the territory.

1.3 Distant Sources, Local Effects: Persistent Atmospheric Pollutants

The transport of organochlorine pollutants is a global issue that has come to the attention of Yukoners over the past few years. Organochlorines are a class of synthetic chemicals that build up in ecosystems. They can enter the air and travel great distances before being returned to the Earth's surface. Predators such as some species of fish or marine mammals can accumulate high levels of these contaminants – high enough to affect the animal itself or humans who regularly eat these animals. Many organochlorines have been banned or restricted in Canada and other countries. However, they are still present in the world's environment.

Organochlorines, especially toxaphene, PCBs and DDT, have been found in fish, polar bears and marine mammals throughout northern Canada.[1] Organochlorines are transported to polar regions through the atmosphere and are scavenged from the winter air by snow and dust. Scientists have examined ice cores from the Aggasiz Ice Cap in the Canadian high Arctic to look at time trends in levels of organochlorines in snow. This research shows that PCBs were deposited in snow in the high Arctic as early as the late 1950s. PCBs continue to be deposited to the present with year-to-year variability but with no clear trend that would indicate reduced PCB emissions.[2]

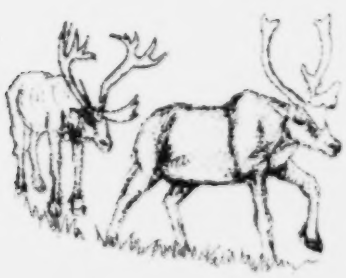
From 1992-1995, levels of organochlorines were measured in snow at sites in the Yukon and northwestern B.C.[3] At sites with low snowfall, the rate at which PCBs are being deposited was similar to the high Arctic sites. However, in the White Pass, an area of high snowfall, total deposition of PCBs over the winter was about 100 times higher. PCBs and other organochlorines at these extremely low concentrations in snow do not pose a health risk. However, these contaminants enter rivers and lakes through snowmelt and build up to higher levels through aquatic food chains.

One of two northern Canadian air quality stations designed to measure trace levels of organochlorines in air ran at Tagish, Yukon from 1992-1995. Results from 1993 show that levels of at least some organochlorines in air are higher in summer than in winter (Figure 1.6). The results also show that air that has passed over parts of the world with high past or present use of organochlorines contains more of these contaminants than air that has passed over the oceans or northern Canada on its way to the Yukon.

These results can be explained in terms of the cold condensation effect (Figure 1.7). As warm air passes over fields that contain residues of pesticides or industrial chemicals, organochlorines vaporize from the soil. As the air cools, the organochlorines condense and form droplets which eventually are returned to the Earth in rain, snow or dustfall. In this way, organochlorines may become airborne and return to land over and over again with seasons and changing weather patterns.

Scientists hypothesize that some organochlorines, such as toxaphene, that move easily into air will continue to travel the air currents around the world for many years, gradually moving from the warmer temperate and equatorial regions to the colder

CREATION OF THE LAND 50,000 - 10,000 B.P.



Caribou and bison, being open country animals, thrived. Bison probably lived in some parts of the Yukon until several hundred years ago.

Figure 1.5
Average ozone layer thickness and UV-B index for Central Yukon, compared with Vancouver and Honolulu

The ozone layer thickness changes naturally over the course of each year. Points along each line represent the average thickness of the ozone layer for each week of the year, from 1978 to 1991, as measured by U.S. polar-orbitting satellite.

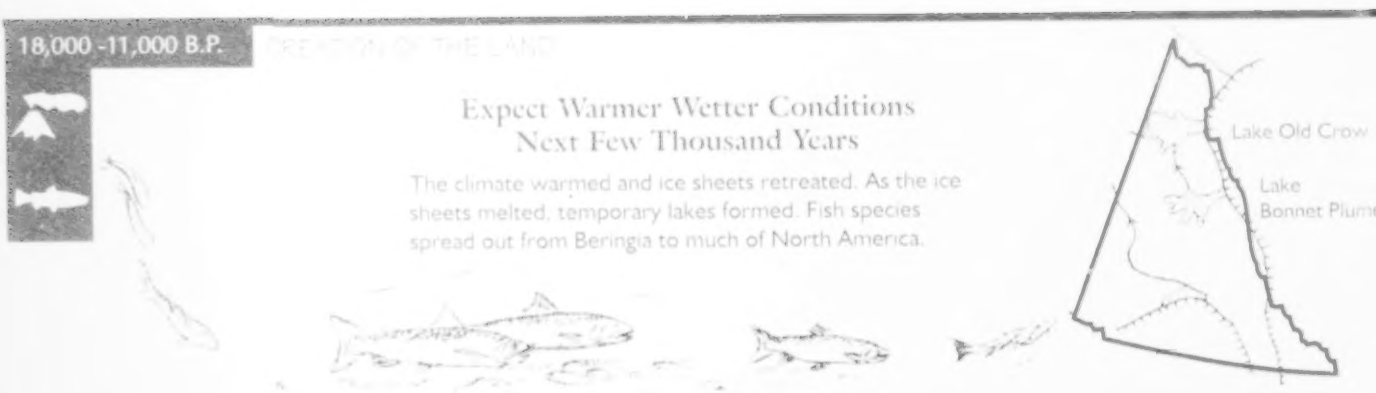
The higher the index, the greater the risk of exposure to UV-B radiation on sunny days. The UV-B index is calculated from the thickness of the ozone layer and the angle of the sun. The lower UV-B index for the Yukon is mainly due to the Yukon's higher latitude. Points along each line represent the average maximum UV-B index for each week of the year, from 1978 to 1991.

index rates the level of exposure to UV-B radiation at a particular time and place. The actual radiation reaching the ground may be much less than indicated by the index if the day is cloudy, or it may be higher in early spring due to reflection from the snow. Figure 1.5 shows that the Yukon, because of its relatively thick ozone layer and because of its high latitude, has UV-B index values in the low to low-moderate range.

The main factor controlling the UV-B exposure received by humans is their own behaviour. The increase in leisure activities (including winter holidays to regions with much higher UV-B radiation levels) has already resulted in higher exposure to UV-B radiation. Human exposure to increased UV-B levels can result in sunburn, premature skin aging, skin cancers, eye diseases and problems with the immune system. Using sunscreen, wearing hats and sunglasses, and minimizing time spent in intense sunlight can lower the risks.

Increasing amounts of UV-B radiation may also affect natural ecosystems and forestry, fisheries and agriculture. UV-B radiation reduces crop yields and affects the growth of algae in lakes and oceans. No research or monitoring directly related to UV-B radiation has been conducted in the Yukon.

Worldwide, CFCs are the main ozone-depleting substances released by human activities. Concentrations of CFCs, which are used mainly in foams, refrigeration and air conditioning, have increased steadily since the start of monitoring in 1977. The rate of increase has declined since 1989, when many countries began measures to reduce the release of CFCs following the Montreal Protocol. These levels can be expected to stabilize and then decline very slowly if international efforts to control ozone-depleting substances are successful.


18,000 -11,000 B.P.
CREATION OF THE LAND
Expect Warmer Wetter Conditions
Next Few Thousand Years
The climate warmed and ice sheets retreated. As the ice sheets melted, temporary lakes formed. Fish species spread out from Beringia to much of North America.
Lake Old Crow
Lake
Bonnet Plum

Canada was one of the first nations to sign the updated Montreal Protocol in 1992. This document commits Canada and other countries to phasing out the import and production of ozone-depleting substances. Regulations under the Canadian Environmental Protection Act have put Canada's commitment into effect. Halons, once used in fire extinguishers, were eliminated in new products in 1993. CFC production will be eliminated by the end of 1995. However, large quantities of these ozone-depleting substances remain in use. The Yukon government is developing regulations to control the reduction and disposal of ozone-depleting substances used or stored in the territory.

Far Distant Sources, Great Effects: Persistent Atmospheric Pollutants

The transport of organochlorine pollutants is a global issue that has come to the attention of Yukoners over the past few years. Organochlorines are a class of synthetic chemicals that build up in ecosystems. They can enter the air and travel great distances before being returned to the Earth's surface. Predators such as some species of fish or marine mammals can accumulate high levels of these contaminants – high enough to affect the animal itself or humans who regularly eat these animals. Many organochlorines have been banned or restricted in Canada and other countries. However, they are still present in the world's environment.

Organochlorines, especially toxaphene, PCBs and DDT, have been found in fish, polar bears and marine mammals throughout northern Canada.[1] Organochlorines are transported to polar regions through the atmosphere and are scavenged from the winter air by snow and dust. Scientists have examined ice cores from the Aggasiz Ice Cap in the Canadian high Arctic to look at time trends in levels of organochlorines in snow. This research shows that PCBs were deposited in snow in the high Arctic as early as the late 1950s. PCBs continue to be deposited to the present with year-to-year variability but with no clear trend that would indicate reduced PCB emissions.[2]

From 1992-1995, levels of organochlorines were measured in snow at sites in the Yukon and northwestern B.C.[3] At sites with low snowfall, the rate at which PCBs are being deposited was similar to the high Arctic sites. However, in the White Pass, an area of high snowfall, total deposition of PCBs over the winter was about 100 times higher. PCBs and other organochlorines at these extremely low concentrations in snow do not pose a health risk. However, these contaminants enter rivers and lakes through snowmelt and build up to higher levels through aquatic food chains.

One of two northern Canadian air quality stations designed to measure trace levels of organochlorines in air ran at Tagish, Yukon from 1992-1995. Results from 1993 show that levels of at least some organochlorines in air are higher in summer than in winter (Figure 1.6). The results also show that air that has passed over parts of the world with high past or present use of organochlorines contains more of these contaminants than air that has passed over the oceans of northern Canada on its way to the Yukon.

These results can be explained in terms of the cold condensation effect (Figure 1.7). As warm air passes over fields that contain residues of pesticides or industrial chemicals, organochlorines vaporize from the soil. As the air cools, the organochlorines condense and form droplets which eventually are returned to the Earth in rain, snow or dustfall. In this way, organochlorines may become airborne and return to land over and over again with seasons and changing weather patterns.

Scientists hypothesize that some organochlorines, such as toxaphene, that move easily into air will continue to travel the air currents around the world for many years, gradually moving from the warmer temperate and equatorial regions to the colder

CREATION OF THE YUKON

50,000 - 10,000 B.P.

Caribou and bison, being open country animals, thrived. Bison probably lived in some parts of the Yukon until several hundred years ago.

south and north polar regions. This does not mean that contaminant levels in the Yukon will decrease. Worldwide use of organochlorines has decreased since the early 1970s and levels of many contaminants have decreased in global ecosystems. If new sources of organochlorines are eliminated, levels in the environment will continue to decrease.

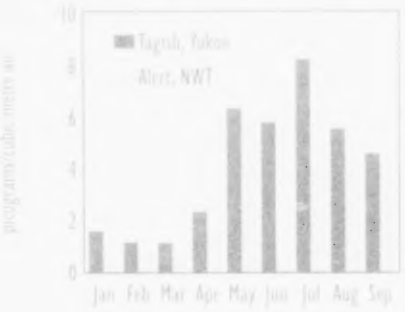
As with greenhouse gases, the control of organochlorines is a formidable task requiring international cooperation and sensitivity to the needs of developing countries.

Figure 1.6
Toxaphene in air at the Tagish air monitoring station

Toxaphene and other organochlorines have been measured in air at two stations in northern Canada as part of studies looking at long range transport of persistent air pollutants. Data to the end of 1993 indicate that levels of toxaphene in air at Tagish, Yukon and Alert, NWT are much higher in summer than in winter. This same seasonal variation occurs at southern Ontario, but there the summer toxaphene levels are about 13 times higher than at Tagish.

Toxaphene levels at each site are closely related to air temperature, and, in fact, can generally be predicted from air temperature. However, some of the weekly air samples at Tagish had higher toxaphene levels than predicted from air temperature. This was because of the different origins of the air masses sampled. The positions of the air masses sampled at Tagish were traced backwards for five days. When these pathways of air masses and levels of toxaphene in air were compared, it was concluded that air samples with higher toxaphene levels than predicted from temperature were from air masses that had passed over Russia or the American mid-west, regions of heavy past use of toxaphene (Map A). Samples with toxaphene levels as predicted from air temperature were from air masses that passed over the Pacific or Arctic oceans or northern and western Canada (Map B).

Monthly average levels of toxaphene in air, Tagish and Alert, 1993



Origins of air that was sampled for toxaphene at Tagish, Yukon, 1993. Lines represent pathways of air over a five-day period, finishing at Tagish.

Map A. Pathways of air with higher toxaphene levels than predicted from air temperature

Map B. Pathways of air with toxaphene levels as predicted from air temperature

12,000 - 9,000 B.P. CREATION OF THE LAND

Where Did They Go?

About 40 species of large mammals became extinct in North America, including dire wolf, mammoths, mastodons and giant beavers. Two hypotheses for this wave of extinction are human overhunting and climate change.

south and north polar regions.[4] This does not mean that contaminant levels in the Yukon will increase. Worldwide use of organochlorines has decreased since the early 1970s[5] and levels of many contaminants have decreased in global ecosystems. If new sources of organochlorines are eliminated, levels in the environment will continue to decrease.

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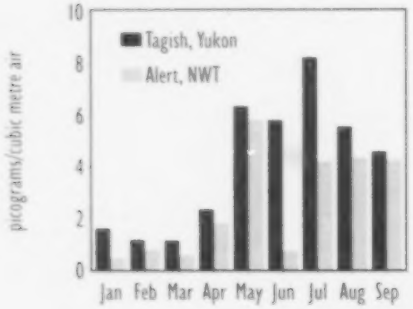

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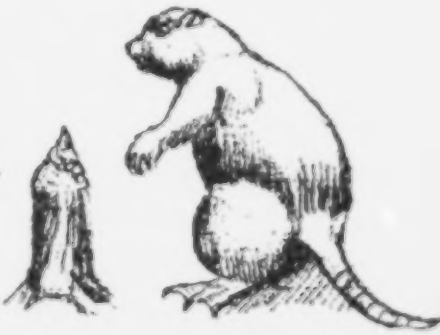


Organochlorines are cheap to produce and effective – for example, there is no current alternative as cheap and effective as DDT for controlling malaria-carrying mosquitoes.

Efforts are underway through circumpolar and United Nations organizations to phase out organochlorine use worldwide. In 1994, Canada and Sweden led a group of nations applying to a United Nations commission on long-range transboundary air pollution to develop a protocol to restrict releases of organochlorines throughout Europe and North America. This application was successful, and Canada is now leading a multinational group developing this protocol. Results of studies of contaminants in ecosystems and of the importance of country foods in the Yukon formed part of the documentation that led the international community to accept the need for this protocol.

Organochlorines are not the only contaminants dispersed around the world through the atmosphere. Metals, particularly cadmium, mercury and lead, and radionuclides are also of potential concern. While metals and radionuclides occur naturally, increased levels can lead to environmental or human health concerns.

Lake sediment cores from the southern Yukon show that mercury deposition from the atmosphere is increasing. This is consistent with the worldwide trend; mercury is released into the air through industrial activities, such as the burning of coal and garbage. Mercury is being deposited into Yukon lake sediments at almost double the rate of pre-industrial times. In eastern Canada, mercury is being deposited into lake sediments at about 10 times pre-industrial rates. Other metals have not increased during industrial times in the Yukon lake sediment cores.[6]

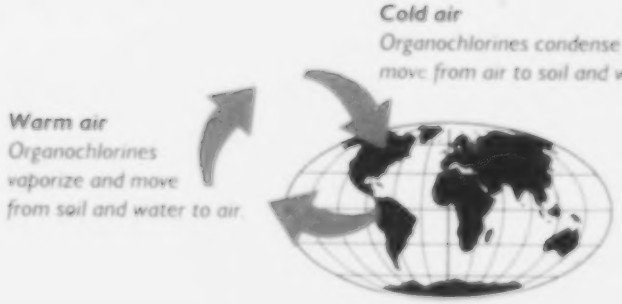
Radionuclides declined to near-natural levels in the 20 years following the reduction of nuclear weapons testing in the 1960s. Releases from the Chernobyl reactor explosion in the USSR in 1986 resulted in an increase in atmospheric concentrations of radionuclides, but the effect of Chernobyl is no longer detectable in the world's atmosphere.[7]

1.4 Local Sources, Local Effects: Yukon Air Quality

The Yukon, with little industry and a sparse population, has few local sources of air pollution. Unlike many southern Canadian cities, Yukon communities are not troubled by smog, which is produced by pollutants from fossil

Figure 1.7
How organochlorines move around the globe: the cold condensation effect

Some organochlorines (such as toxaphene, PCBs and DDT) vaporize from soil and air in tropical and temporate latitudes. They move through the atmosphere and, when they encounter a colder air mass, condense into tiny drops attached to dust particles. The organochlorines then return to the earth's surface on dust particles or through rain or snow. Scientists are constructing models based on the properties of organochlorines to predict how concentrations of these contaminants at different latitudes will change over time.


Cold air
Organochlorines condense and move from air to soil and water.
Warm air
Organochlorines vaporize and move from soil and water to air.

CREATION OF THE LAND

Forests reappeared about 8,000 years ago and tree species changed during glacial melt and warming.

Mink-man went to several women and told them about their husband, Raven, being killed. When one woman heard the story, she cried and pinched her skin. Then she was changed into the spruce tree, with its rough pinched bark.

When another heard it, she cried and slit her skin with a knife. She became a poplar, with its deeply cut bark.

When a third woman was told the story, she cried and pinched herself until she bled. She turned into the alder, whose bark is used to make red dye.

fuel combustion interacting with sunlight. Episodes of bad air quality in Yukon communities usually occur on cold, calm winter days, when smoke from wood-burning stoves and vehicle exhaust is trapped in a lower layer of stagnant air. High dust levels also occur in communities, especially on windy spring days, and, occasionally, forest fires result in blankets of smoke that spread over a region for several days. Pollen from trees and flowering plants could be considered a natural air contaminant, as seasonal episodes of high pollen counts affect allergy sufferers. Radon, another natural contaminant, may be present in the air in houses built on land containing uranium.

Radon and Indoor Air Quality

Radon is a naturally-occurring colourless, odourless gas emitted by uranium at a slow and steady rate as it decays. Radioactive emissions from radon can cause cancer in humans who are exposed to the gas over a long period. Because radon gas seeps through dirt basements, cracks and joints and builds up in poorly-ventilated houses, the radon level in a home depends both on the level of uranium in the ground at the building site and on the construction of the house.

The Yukon Department of Economic Development does radon testing and provides information on how to reduce radon levels in houses. Because this service is on an as-requested basis and results are confidential, there is no comprehensive, accessible database of radon levels in Yukon homes. In general, testing has indicated that radon concentrations may be above recommended levels in houses in some areas. The Wolf Creek subdivision near Whitehorse is an area of naturally-high radon. Corrective measures have been taken by several homeowners to reduce radon levels in Wolf Creek homes.[1]

The Yukon's major sources of air pollution are from the combustion of fuels and the open burning of wastes. Burning releases a mixture of fine particles and gases to the air. Some of the products of burning are greenhouse gases, including nitrogen oxides and volatile organic compounds which can be harmful to plants and animals, including humans. Emissions from gasoline-burning vehicles produce particles containing toxic organic chemicals. Diesel engines also produce fine particles often laden with organic chemicals. Perhaps the most complex source of air toxics is the combustion of domestic waste at low temperatures.

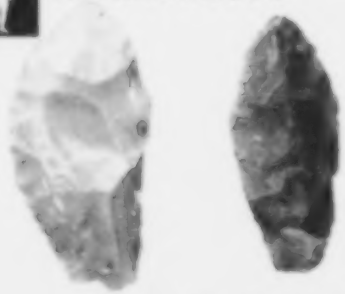
Particulate matter from smoke and dust reduces visibility and can harm human health. Finer particles can be deposited in the human respiratory system. Children, the elderly, smokers and those suffering from lung disorders may be particularly susceptible. High levels of fine particulates occur occasionally in some Yukon communities on cold winter days when the movement of air is restricted. Common sources of fine particulates in Yukon communities are wood stoves, vehicle exhaust and diesel power generation. Monitoring of air particulates is conducted only in Whitehorse (see Section 6.4).

Improvements in technology and stricter regulation have led to improvements in emissions from motor vehicles over the past 20 years. New cars in Canada now emit only 24 per cent of the

Pollen

Pollens from trees and flowering plants affect approximately 10 per cent of the Yukon population. Research conducted at the Whitehorse General Hospital in 1984 identified 21 pollens, with lodgepole pine being the most abundant. This research into seasonal and diurnal variations in pollen concentrations was to be used to develop a pollen calendar to aid those with allergic disorders. However, research funding is no longer available and the hospital testing program has been put on hold.[2]

PEOPLE IN THE LAND



Spear points, Northern Archaic Tradition

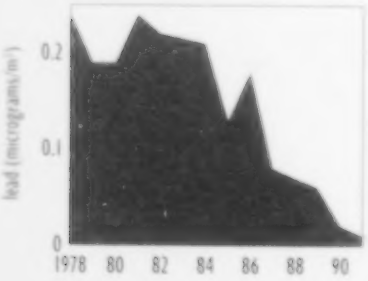
- 10,000 - 8000 B.P. **Northern Cordilleran Tradition**. Oldest evidence of human occupation in Yukon.
- 8000 - 4000 B.P. **Northwest Microblade Tradition** (Little Arm Phase in Southwest Yukon). Small, replaceable stone blades called microblades were inserted into tools made of bone or antler.
- 5000 B.P. **Northern Archaic Tradition**. In southwest Yukon, also called Taye Lake Phase. Stone net sinkers provide first evidence of people fishing. Tools and exotic stone such as obsidian indicate local and long-distance trade networks among Yukon peoples.

nitrogen oxides, four per cent of the volatile organic carbons and four per cent of the carbon dioxide of new cars in the 1970s.[3] However, these improvements have been partly offset by increased numbers and use of passenger vehicles in Canada over that time period. The number of vehicles registered in the Yukon has doubled since 1974, from almost 11,000 to almost 22,000.[4]

Despite the increase in vehicle use, measures to control lead in vehicle exhaust have proven very effective. Lead additives in gasoline were phased out of use in Canada between 1974 and 1990. This action has dramatically lowered lead levels in air across the country, including in the Yukon (Figure 1.8).

Figure 1.8
Lead in air, downtown Whitehorse, 1978-1991

Lead in particles in Whitehorse air has declined dramatically as a result of the phase-out of leaded gasoline in Canada.



Protection of Yukon Air Quality

There is no Yukon-wide legislation related to the protection of air quality. Although the Yukon Environment Act allows for the control of air emissions and the setting of standards for air quality, regulations under the act would have to be developed for the legislation to take effect (Environment Act, Part 9). Zoning regulations and municipal bylaws control air emissions in some circumstances. For example, woodsmoke from home heating is controlled in Riverdale, a neighbourhood of Whitehorse, through a municipal bylaw (see Section 6.4). The Yukon Area Development Act allows for regulations to be developed to control air emissions on territorial lands. This act is used to control industrial open burning in the Golden Horn area near Whitehorse.[5]

Federal legislation in Canada sets standards for vehicle emissions in new cars and trucks offered for sale (Transport Canada legislation) and regulates the amount of lead in gasoline (Canadian Environmental Protection Act). But used vehicles offered for sale and operating vehicles are not required to meet emission standards. Gasoline sold in the Yukon is tested regularly by Environment Canada to ensure that its lead content complies with federal legislation.

PEOPLE IN THE LAND

1500 B.P. First evidence of bow and arrow and use of native copper for the manufacture of tools and ornaments.

1800 A.D. **Bennett Lake Culture** in Southwest Yukon. Log house construction and access to Euro-American trade goods. There is evidence that Yukon peoples were part of a trade network that extended far to the south and north. They used European trade goods decades before seeing white traders.

microblades
Northwest Microblade Tradition

Chapter 2 Water

The Yukon's abundant freshwater resources are stored in lakes, wetlands, streams, glaciers, snowpacks and groundwater systems. They eventually flow into the Bering Sea via the Yukon River, the Gulf of Alaska via the Alsek River, or the Beaufort Sea through the Liard, Peel, and North Slope drainages (Figure 2.1).

2.1 Stream Flows, Lake Levels and Groundwater Aquifers

The flows of streams and the levels of lakes and groundwater tables are regulated by climatic elements (precipitation, snow and glacier melt, and evaporation), as well as physical characteristics (topography, vegetation and permafrost) as shown in Figure 2.2. Significant changes in climate, particularly air temperature and precipitation, alter streamflow patterns. A temperature increase, for example, might lead to increased glacial melt and higher stream flows in some areas.

An analysis of average annual flows of 13 British Columbia and Yukon rivers showed a tendency towards increased average flows in northern British Columbia and decreased flows in the south of the province. The average annual flows at the two Yukon sites examined (Takhini and Yukon rivers) have not changed significantly over the years.[1]

Long-term average flows of the Yukon River are shown in Figure 2.3. In the winter, moisture on

Figure 2.1
Drainage basins of the Yukon

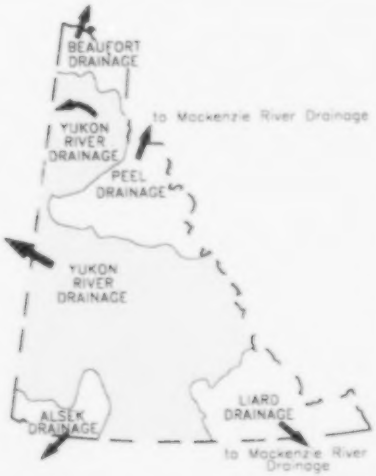
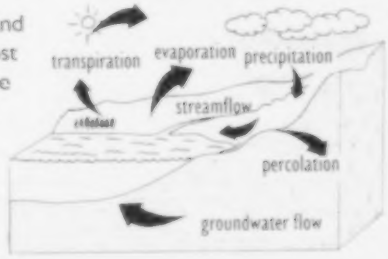


Figure 2.2
The water cycle

Water is stored in lakes, streams, snowpacks, glaciers and underground aquifers. It enters the atmosphere by evaporation from the surfaces of water and land, or from transpiration by plants. Most rain clouds in the Yukon come in from the Gulf of Alaska or from the Beaufort Sea. When moisture condenses in the atmosphere, it returns to the earth as rain or snow. On the earth's surface, water flows into streams or percolates through aquifers as groundwater.



1250 B.P. PEOPLE IN THE LAND

Cloudy with a Chance of Ash

Volcano eruption near the headwaters of the White River in Alaska spreads volcanic ash over most of south and central Yukon. The eruption was likely accompanied by clouds of dust and noxious gases that forced people and animals out of the central Yukon for many years. The pale ash layer can still be seen along river banks and cutbanks.

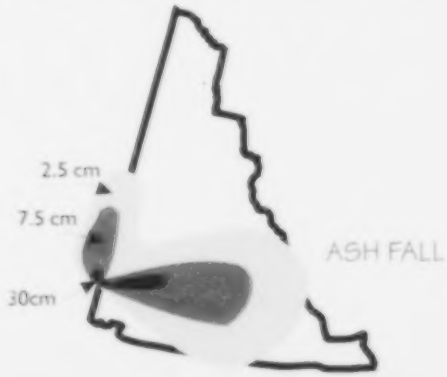
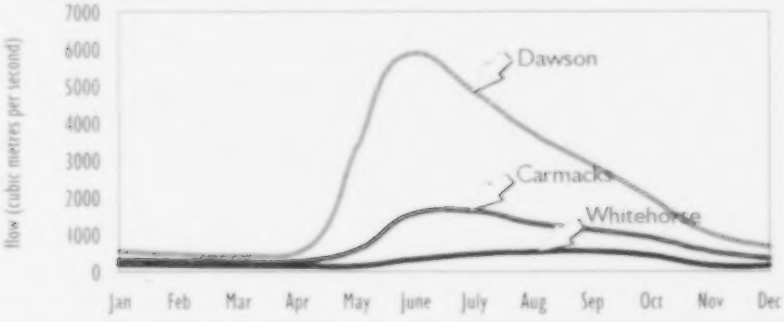


Figure 2.3
Seasonal variation in flow of the Yukon River at Whitehorse, Carmacks and Dawson City

The volume of water in the Yukon River increases moving downstream from Whitehorse to Dawson through the addition of tributary streams and groundwater flow. Glacial melt keeps water levels high at Whitehorse until September. The peak flow at Dawson in June results from the melting snowpack in the Yukon's interior. Data are monthly averages from 1943 (Whitehorse), 1951 (Carmacks), and 1945 (Dawson) to 1990.



land is tied up in ice and snow. Streamflow is composed of groundwater. Spring melt brings a rapid increase in flow, augmented by glacial meltwater and rain.

The abundance of fresh water is locally affected by human activity such as the withdrawal, diversion, or storage of water for industrial or domestic use. Although demands on Yukon surface waters have not resulted in the major disruptions of natural flows experienced in many jurisdictions, hydroelectric development and mining have altered flow patterns in some locations. Dams at Whitehorse Rapids, Mayo River and Aishihik Lake have altered the flow of surface waters (see Sections 4.2, 5.1 and 6.4).

In general, water shortages have not been a problem in the Yukon. Water abundance varies naturally from year to year and high and low streamflows can affect human activities and aquatic habitat. Bank flooding and property damage are the most obvious results of high water.

Hydroelectric generation depends on water availability. When water flows are low, we become more dependent on diesel fuel for the generation of electricity. When water levels are abnormally high, flooding can occur in storage reservoirs.

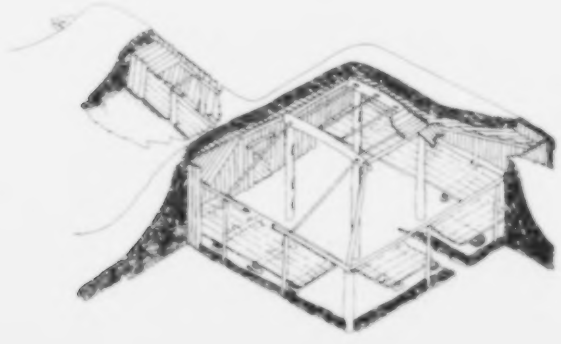
Migrating salmon are affected by water flows. In low-water years, adult salmon can not always reach their traditional spawning grounds. Chum salmon spawn in the groundwater-fed backwaters along several large Yukon rivers. If water levels are low in the spring, young salmon cannot escape from the backwaters into the rivers. During high-water years, salmon migrate further up the drainage basin. Extremely high water levels carry silt loads that damage spawning beds.

Measuring Stream Flow

A territory-wide network of permanent hydrometric (water measuring) stations is maintained by Environment Canada. These stations provide flow data year-round. The Department of Indian Affairs and Northern Development (DIAND) also operates a network of hydrometric stations on small streams during open water. About 90 stations were in service in 1995, but some are being eliminated due to federal budgetary constraints.

The information provided by the hydrometric monitoring network is used for estimating water availability for industry, flood forecasting, designing culverts and bridges, and determining water levels for river navigation. Streamflow information is also used to predict levels of contaminants in water bodies downstream from proposed industrial developments and to monitor long-term environmental change.

PEOPLE IN THE LAND — 1000 B.P.



Driftwood Houses

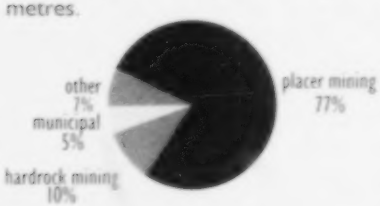
The Thule people were the ancestors of the modern Mackenzie River Inuit. They built wood-frame houses from driftwood that floated down the Mackenzie River. It was the Qikiqtarugmiut, descendents of the Thule, who met explorer Sir John Franklin at Herschel Island in 1826.

Groundwater

Not much is known about the quantity or quality of our groundwater aquifers. To better understand the extent of this resource, a groundwater database is being established by DIAND. The database includes the location of each water well, a geological description of the aquifer, the quantity of water the well can produce and information on water quality. Data are collected from well drillers' logs (provided voluntarily), government monitoring programs and reports by engineering consultants.

Figure 2.4
Water allocation by sector, 1993

Total water allocated through water licences in 1993 is shown by sector. The total amount of water allocated for use in 1993 was 233 million cubic metres.



Notes:
- hydroelectric generation not included
- "other" includes agriculture and fish farming
- placer mining allocation is based on water licences in effect in the 1993 season, an average season of 110 days and a 12 hour working day

Allocating Water

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2.2 Water Quality

Two national sets of guidelines are used in the Yukon to assess the quality of water:

- drinking water guidelines, based on safety of water for human consumption and on taste, odour and appearance of water;[1] and,
- guidelines for the protection of freshwater aquatic life, based on the suitability of water to maintain healthy aquatic ecosystems.[2]

Many people believe that any water fit for people to drink is good-quality water. Humans, however, are not the only users of water. Sensitivity to pollutants varies. Fish, aquatic insect larvae and algae are less tolerant of some substances than are humans. For example, zinc, a metal that enters some Yukon surface waters either from natural sources or from mining activity, presents no health risk to people in the concentrations found in Yukon waters. Even where zinc is added to the water by natural or mining-related acid rock drainage, levels are well within the guidelines for drinking

Ice Jams and Flooding

Flooding in the Yukon may be caused by very high streamflows resulting from heavy rainfall events or from the rapid melting of the snowpack and glaciers. The more dramatic floods, however, are usually caused by ice jams. Dynamic ice jams, such as the one responsible for the 1979 flood in Dawson, occur when fragmented ice floes are transported downstream until they meet some obstruction. Flooding can also occur during freeze-up. Ice-dams, such as those occurring at the Marwell area of Whitehorse, are formed when frazil ice (ice crystals in turbulent water) bridges with shore ice and anchor ice (ice on the streambed). The flooding of Marwell at freeze-up has been less of a problem since the hydroelectric dam was built at Whitehorse Rapids because the water is less turbulent.[2]

1350 - 1870 PEOPLE IN THE LAND

Outlook for the Next 500 Years — Chilly

The Little Ice Age - the climate cooled in many areas. Mountain glaciers and polar ice caps expanded. In 1826, the Franklin expedition fought through this heavy ice and reached Herschel Island. They were the first Europeans to see the Yukon.

Ships trapped in ice near Point Barrow, Alaska, 1876. From a sketch by Captain William H. Kelly

water. Zinc, however, is toxic to fish and other aquatic organisms at low levels. The drinking water guideline for zinc is 5 milligrams per litre, whereas the recommended guideline for the protection of aquatic life is 0.03 milligrams per litre. Control of zinc levels is a major focus of water management for several mining projects.[5]

Short-term studies of Yukon water have shown that quality is generally very good. Most metals and other natural constituents are within recommended guidelines for the protection of freshwater life and for drinking water.[5] Surface waters are generally soft and slightly alkaline, showing the influence of the volcanic ash layer deposited over much of the territory 1,500 years ago.

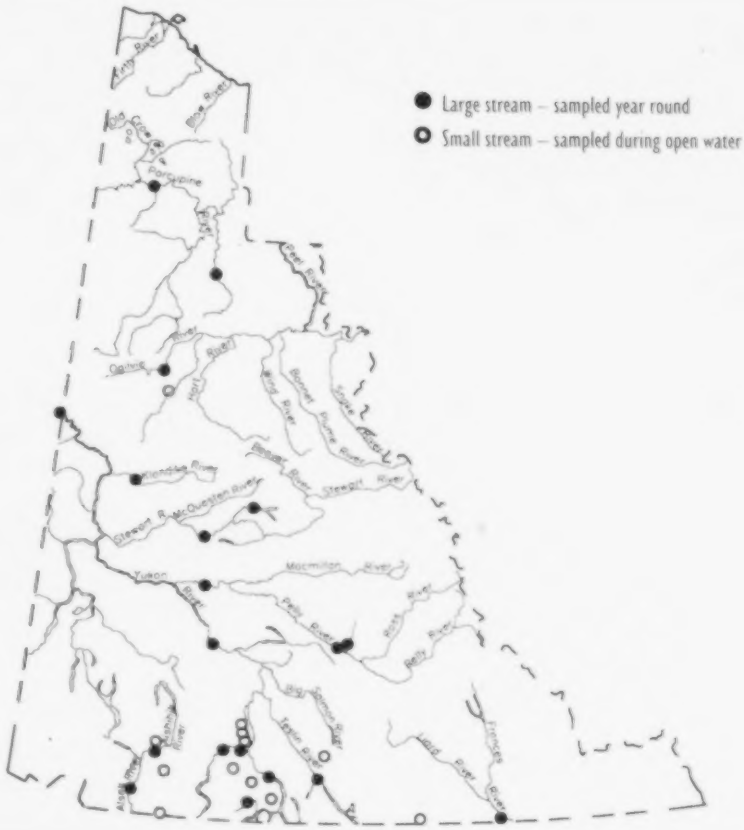
Water quality was sampled at 21 stations in the Yukon River basin over a 13-month period in 1982-83. At some locations drinking water guidelines were not met for turbidity, colour, iron and manganese. These guidelines are related to the taste, odour or colour of water rather than to any risk to human health. In some rivers the guidelines for the protection of aquatic life were not met for copper and lead during periods of high water. This was related to erosion of highly-mineralized soils.[5]

Water Quality Monitoring

To get a clear picture of the quality of our surface waters, a long-term, continuous record of reliable data is required. Water quality monitoring stations have been established on large and small streams in the Yukon (Figure 2.5).

Environment Canada monitors 12 water quality stations on large rivers in the Yukon. Samples are collected year-round during hydrometric field surveys. DIAND monitors water quality at nine stations on large streams on a bi-weekly, year-round basis and 12 stations on small streams on a weekly basis during open water

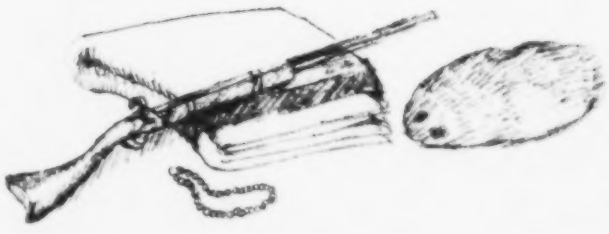
Figure 2.5
Yukon water quality stations



PEOPLE IN THE LAND 1800s

European trade with Tlingit along Pacific Coast well-established.

Coast Indians got guns, matches, knives, axes . . . sugar, tea, tobacco, cloth to sew. They traded with interior Indians for clothes and furs. I never saw those axes of the traders from the coast; when my grandma was young, she saw them.
— Annie Ned, Hutshi Elder



Groundwater

Not much is known about the quantity or quality of our groundwater aquifers. To better understand the extent of this resource, a groundwater database is being established by DIAND. The database includes the location of each water well, a geological description of the aquifer, the quantity of water the well can produce and information on water quality. Data are collected from well drillers' logs (provided voluntarily), government monitoring programs and reports by engineering consultants.

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1800s

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Annie Ned, Upper Liard

(Figure 2.5). To reduce network operating costs and include more Yukoners in the monitoring process, local people collect water samples and carry out field measurements. DIAND also monitors the quality of licensed effluents and adjacent receiving waters.

Few long-term data sets are available from these sites and critical analysis of the data is just beginning. Because of this, there is no information available on overall trends in Yukon water quality.

Table 2a
Yukon municipal water supplies

community	surface water	community wells	private wells
Beaver Creek			•
Burwash Landing		•	•
Carcross	•	•	
Carmacks		•	•
Dawson City		•	
Destruction Bay			•
Elsa		•	
Faro		•	
Haines Junction		•	
Keno City		•	
Mayo		•	
Old Crow		•	
Pelly Crossing		•	•
Ross River		•	
Swift River		•	
Tagish		•	•
Teslin		•	
Upper Liard		•	•
Watson Lake		•	•
Whitehorse	•	•	•

Drinking Water

Domestic water supplies are provided by municipal governments in the larger Yukon centres. The Yukon Community and Transportation Services Branch and Indian and Inuit Affairs Canada supply water in smaller communities. Both surface water and groundwater sources are used. Water reaches homes by piped systems and delivery truck. Many homes have private wells. Outside Whitehorse, most Yukoners obtain their water from groundwater. Whitehorse's water supply is surface water (Schwatka Lake) mixed with groundwater to raise its temperature in the winter and dilute the silt in the summer.

Table 2a shows the sources of water in all Yukon communities. Piped water systems in the Yukon are all chlorinated, as are some of the truck delivery systems. Water holding tanks on trucks and in homes become contaminated with bacteria if not kept clean. The safety of water in terms of risk of disease is monitored by analysing water for faecal coliform bacteria. These bacteria are not in themselves harmful, but they indicate that the water has been contaminated with human or animal faeces and that other disease-causing organisms may be present. No faecal coliforms are acceptable in drinking water.

In the summers of 1993 and 1994, Health Canada carried out a survey of drinking water safety in Yukon communities.[6] Samples from each community's water supply were analysed for water chemistry and bacteriological contamination. Survey results, shown in Table 2b, show that water quality guidelines are met for most Yukon community water supplies. Where water quality did not meet all drinking water guidelines, it was for parameters that affect the taste and appearance of the water (such as iron, manganese, sulphide, and turbidity), rather than those that pose a risk to human health. Coliform bacteria analyses show good quality at most sites. Bacteriological contamination was detected at some private wells that were subject to localized pollution from septic fields and in the drinking water holding tanks of some communities.

Sources of Impacts on Water Quality

Sewage

Raw sewage contains suspended solids, nutrients such as nitrogen and phosphorous, disease-causing microorganisms (bacteria, viruses, and protozoans) and ammonia, which is toxic to fish. Raw sewage from Yukon communities does not contain the contamination from metals found in more industrialized regions. Sewage also contains a mix of toxic chemicals – whatever people decide to pour down their drains.

1840 CONTACT

The Bay Comes to the Yukon

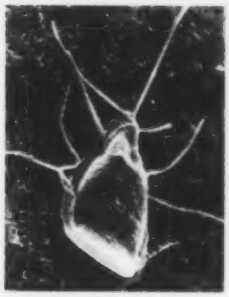
In 1840, Robert Campbell of the Hudson's Bay Company entered the Yukon via the Liard River in search of new fur sources. He established three posts, the final one at Fort Selkirk in 1848. In 1852, the coastal Tlingits sacked the post and drove out their rival. The HBCo. did not return to Fort Selkirk for 86 years.

The effects of these contaminants on the Yukon's surface waters include risks to human health and the aquatic environment.

Microorganisms in sewage cause a variety of diseases such as gastro-intestinal illness, hepatitis A, and giardiasis (Figure 2.6). Bacterial contamination from sewage is a problem in cold surface waters. Coliform bacteria from Whitehorse's sewage effluent persist downstream as far as Lake Laberge. Higher coliform counts have been measured in winter when the constant sewage discharge combines with low river flows, cold water and ice cover to provide ideal conditions for these bacteria (Figure 2.7).

Giardia in Yukon Waters

Giardia is a microscopic parasite that inhabits the small intestines of most species of mammals, including humans. Symptoms of giardiasis, the disease caused by *Giardia* infection, may include nausea, diarrhoea, flatulence, abdominal cramps, fatigue, weight loss, fever and chills. Many people harbouring giardiasis show no symptoms. Other patients have recurring bouts of the disease that may persist for months.



Giardia, free-living form, length = 13 microns (scanning electron microscope photograph)

Recent surveys have shown that *Giardia* cysts occur in Whitehorse municipal drinking water as well as in sewage samples from several Yukon communities. *Giardia* cysts have also been found in surface waters at many locations in the Yukon.

Disinfection of drinking water with chlorine is seldom effective. Filtration and boiling are the most reliable ways to kill *Giardia* cysts in water.[7]

Table 2b

Survey of drinking water quality, 1993

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Chemical analyses were for physical properties, major ions, cyanide, total metals, sulphide, halogenated and non-halogenated volatiles, benzo(a)pyrene, and chlorinated phenols.

Drinking water guidelines for iron, manganese, sulphide and turbidity are all related to taste, colour, smell or scaling properties of the water, and not to health risks.

Relevant Canadian drinking water standards	
iron	0.3 mg/L
manganese	0.05 mg/L
sulphide	0.05 mg/L
turbidity	5 NTU

Drinking water supplies tested:	Drinking water quality met all guidelines with these exceptions:
Beaver Creek	-
Burwash Landing	manganese (0.07 mg/L)
Carcross	manganese (0.09 mg/L)
Carmacks	manganese (0.26 mg/L)
Champagne	iron (0.77 mg/L)
Canyon Creek	-
Dawson City	-
Destruction Bay	sulphide (0.21 mg/L)
Faro	-
Haines Junction	-
Mayo	-
Old Crow	manganese (0.17 mg/L)
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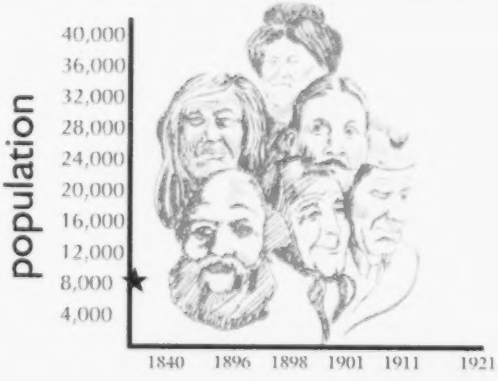

CONTACT 1800s

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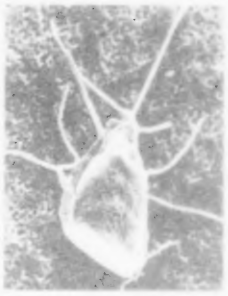

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Whitehorse	–

CONTACT
1800s
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Sewage is not the only means of faecal contamination of water. Faecal coliforms, the most commonly used indicator of faecal contamination, are intestinal bacteria found in all warm-blooded animals. Faecal contamination in Kluane Lake near Destruction Bay, for example, is believed to originate from faecal deposits on the ice and shoreline by dogs and not from the sewage treatment lagoon.[8]

The Yukon's cold surface waters are generally low in nutrients. Excessive growth of algae downstream of sewage outfalls, a common problem in warmer climates, is rare in the Yukon. Reduction of oxygen levels resulting from the bacterial breakdown of organic material found in sewage has also not been a problem in Yukon waters. Sewage effluents are quickly diluted. The potential for reduced oxygen levels in northern waters exists, however, because dissolved oxygen is easily depleted in ice-covered water.[9]

Municipal sewage in the Yukon is treated before it is released into the environment (Table 2c). Most Yukon communities use lagoon systems, which settle out solids and begin the bacterial breakdown of organic matter. Other methods include the mechanical screening system in Dawson and the extended aeration plant in Carmacks. Some smaller communities rely on private septic systems or community septic pits.

Some of the Yukon's sewage treatment systems are new and efficient and have little or no impact on water. For example, the large lagoon systems at Mayo and Watson Lake have no discharges to surface waters. Other sewage treatment systems, such as Dawson and Whitehorse, require upgrading (see Section 6.4). Whitehorse, Carmacks and Dawson are the only communities discharging sewage continuously into surface waters. Sewage from other communities, such as Haines Junction, Destruction Bay and Faro, is stored in large lagoons and periodically discharged to the environment.

Figure 2.7
Faecal coliform bacteria in the Yukon River, winter 1991

The concentrations of faecal coliform bacteria in the Yukon River increase dramatically downstream from the Whitehorse sewage outfall. During winter, the bacteria persist further downstream than during summer. Faecal coliform bacteria are indicators of possible contamination by disease-causing microorganisms. This situation will be considerably improved when the new sewage treatment system is completed.

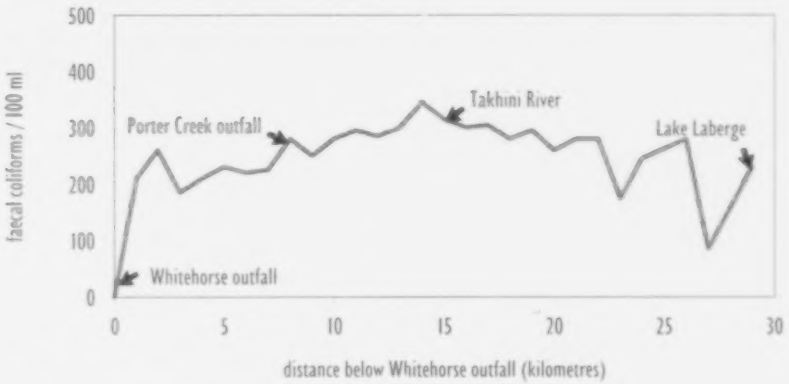
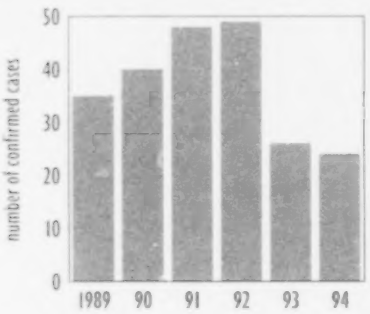


Figure 2.6
Number of giardiasis cases reported per year

Evidence provided by Yukon physicians suggests the incidence of giardiasis is much higher than the number of reported cases indicates. However, not all giardiasis cases are contracted from drinking water.



1852 CONTACT

Galloping Glaciers!

Lowell Glacier surged to form an ice dam across the Alsek River, creating Lake Alsek. The dam broke in 1875, draining the lake and causing floods. There is evidence that this had happened several times previously.

Forestry and Mining

Some streams in the Yukon are altered locally by activities related to mining or forestry (see also Section 4.2). Effects from forestry are related to stream crossings and erosion from logging and from construction of access roads. Wood debris also clogs streams and alters aquatic habitat. Good logging practices and strips of intact vegetation along stream banks reduce these effects. Specific requirements to protect water quality are set as conditions of permits or agreements related to timber harvest, or as conditions of land use permits required for the creation of access to harvest areas.

Some changes to water quality can be expected when large quantities of water from a stream are diverted and used to process ore or placer dirt. The current federal environmental assessment and regulatory regime requires that these changes to water quality should have no significant effects on downstream aquatic ecosystems and that they should not affect the water supplies of licensed downstream water users. Placer mining, however, has had significant effects on aquatic ecosystems in heavily-mined streams. New regulations are designed to reduce the extent of these effects and to rehabilitate streams following mining (see Section 5.3).

The main impact from placer mining is the release of sediments to streams, both through increased erosion from the stripped ground and through discharges of mine effluent. Effluent from the sluicing process is run through one or more settling ponds to remove some of the settleable solids. These settling ponds, however, are often located in or near the natural streambed and can be a source of further sediment to the stream through wash-outs at high water. Mines in steep, confined valleys often have difficulty creating adequate settling pond systems.

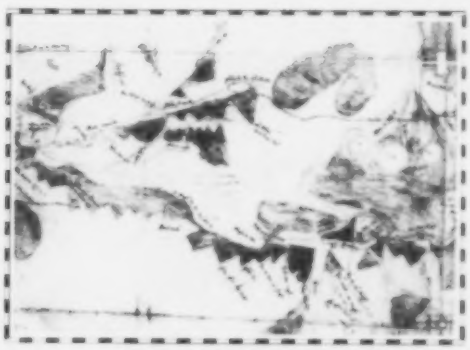
The exploration and development phases of hard-rock mining may also cause erosion and the release of sediment into lakes and streams. When acid-generating rock is exposed, acid rock drainage is created, increasing the release of metals into water. This is sometimes a slow process and might not begin to affect water quality until years after mining activity has ceased.

Operating hardrock mines use water and chemicals to extract and concentrate metals. Metals and reagents used in ore processing, such as cyanide, often appear in mill effluents, as does ammonia, which is used in explosives and is a by-product of cyanide degradation

Table 2c
Yukon municipal sewage treatment systems

community	sewage treatment type				
	lagoons	aeration	screening	septic	pump-out
Beaver Creek				•	•
Burwash Landing				•	•
Carcross				•	•
Carmacks		•			•
Dawson City			•		
Destruction Bay	•				
Faro	•				
Haines Junction	•				
Keno City				•	
Mayo	•				
Old Crow	•				•
Pelly Crossing				•	•
Ross River				•	•
Tagish				•	•
Teslin	•				•
Upper Liard				•	
Watson Lake	•				
Whitehorse	•			•	

CONTACT 1869



First Map of the Southwest Yukon

Chilkat Chief Kohklux and his two wives drew a map of the routes into Yukon interior for American scientist George Davidson. Explorers, traders and prospectors began trickling into the Yukon interior.

in gold-milling (see Section 6.5). Effluent and site seepage are collected and treated as necessary to meet standards before release to streams. It can be difficult to recover all groundwater seepage and sometimes groundwater at a minesite must be pumped and treated so that it will not contaminate streams.[10]

Abandoned mines affect water quality because of chemical or physical instability of waste rock dumps, pits, adits, or tailings impoundments. Acid rock drainage can develop or persist at a site after closure and the drainage might require control methods such as relocation of acid-generating rock, covers over tailings ponds, or long-term water treatment (see Section 6.5).[11]

Spills

When accidental fuel and chemical spills occur on land, surface and groundwater can be contaminated if the spills are not cleaned up. Petroleum is the most frequently spilled product in the Yukon. Diesel fuel is the most common, followed by asphalt emulsions and gasoline (Figure 2.8).

Emergency spill response and spill prevention in the Yukon is coordinated by Environment Canada. Spill response coordinators provide a 24-hour reporting centre to receive reports of environmental emergencies, coordinate other government agencies in responding to spills, and promote the development of contingency plans with industry and government to encourage emergency preparedness.

Contaminants from Atmospheric Transport

Human-produced chemicals such as PCBs and organochlorine pesticides are transported through the atmosphere from other parts of the world and enter the Yukon's aquatic environment through rain and snow (see Section 1.3). Some of these chemicals, notably DDT and PCBs, have also been used in the Yukon.

Levels of organochlorines were measured through a sampling program in the upper Yukon River and headwater lakes from 1992 to 1994.[12] Because these contaminants are found in such low levels in water, samples of up to 100 litres of water were required even to detect the contaminants. PCBs were not markedly higher at any location and levels were low compared with PCB levels in lakes close to major industrial centres or with a history of extensive PCB use (Figure 2.9). Results were similar for other organochlorines. The conclusion is that the main source of organochlorines now present in Yukon River water is long range atmospheric transport, not local releases. There is, however, evidence from sediment analyses in Lake Laberge that PCBs leaked or were spilled into water in the 1950s, a time of high PCB use in the Whitehorse area.[13]

Acid Rock Drainage

The concern with Acid Rock Drainage (ARD) is usually with the metals that remain in the water as it travels downstream. These metals, unless kept to very low levels, will affect the fish and other aquatic life. ARD is formed when rock with a high sulphur content is exposed to oxygen and to water. The sulphur, water and oxygen react chemically to produce sulphuric acid which dissolves metals from rocks. The metal-laden acid is diluted with groundwater or surface water and is often neutralized. Many of the metals precipitate and enter the stream sediments or form a distinctive orange coating on the stream bottom. Some metals, however, are left in solution and remain in the water as it travels into streams and lakes. In the Yukon, the main metal of concern usually found in ARD is zinc. ARD is a natural phenomenon – it needs nothing but rock, air and water. There are several areas in the Yukon where ARD occurs from natural outcroppings, for example in Macmillan Pass, Clear Lake in the Pelly River Basin, and Engineer Creek along the Dempster Highway. ARD can also occur through mining. When high-sulphur ores are mined, tailings are usually acid-generating. Because the rock around the ore deposit is often also high in sulphur, sections of pit or underground mine walls and waste rock dumps often produce ARD.

GOLD RUSH

GOLD!

1884 Gold on the Stewart! - This was the first gold strike that attracted men in substantial numbers to the Yukon. From the Stewart, they fanned out to search other rivers.

1886 Gold on the Fortymile! - By 1887, the area had yielded $75,000 in gold and about 300 men were in the vicinity. Until the discovery of coarse gold at Fortymile, mining was mostly seasonal, on river bars. The simple pan and shovel gave way to shafts, fire thawing, sluices and the buildings required for overwintering.

Regulation

The use of fresh water and the disposal of wastewater are regulated under the Yukon Waters Act and the Fisheries Act, both federal legislation.

A licence under the Yukon Waters Act is needed to use water or to deposit wastewater into streams or lakes. Water licences are issued by the Minister of Indian Affairs and Northern Development or the Yukon Territory Water Board. The maximum limits of water that can be used without a licence are set out in the act's regulations.

The Fisheries Act states that no harmful substance may be dumped into fish-bearing waters, or waters leading to fish-bearing waters. It also contains provisions for the protection of fish habitat. The Yukon Placer Authorization (YPA), which sets effluent limits for suspended solids in Yukon placer effluent, and the Metal Mine Liquid Effluent Regulations (MMLERs), which set effluent limits for some common constituents of base metal mine effluents, arise from the Fisheries Act. Water licences issued under the Yukon Waters Act incorporate effluent standards that must be at

Figure 2.8
Petroleum spills, 1983-94

The most fuel spilled in the Yukon was in 1991, when 20 spills released 175 tonnes of petroleum into the environment. Not all petroleum spills end up in the water. (Note: only spills of over 150 litres are included in this graph.)

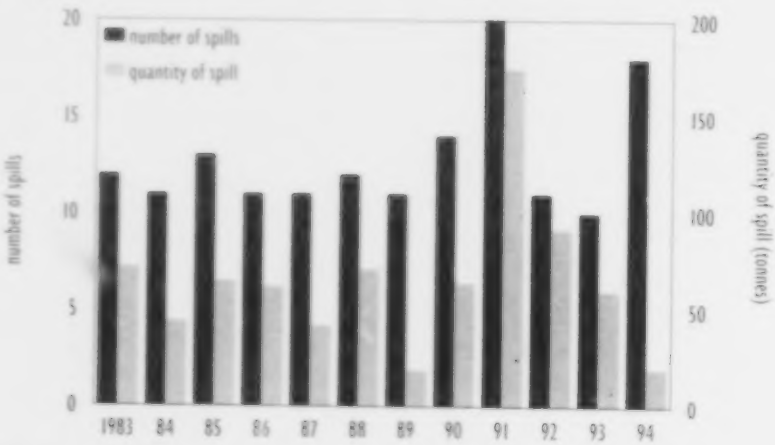
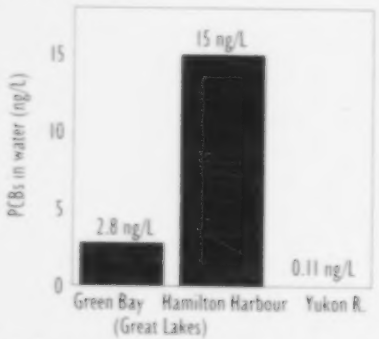


Figure 2.9
PCBs in Yukon River water compared with the Great Lakes

Average PCB levels in Yukon water, based on 1993 sampling at 11 locations on the Yukon River and headwater lakes, are much lower than Great Lakes levels. No current local sources of PCB or other organochlorine contamination were detected.



Note: measurements are nanograms (billionth of a gram) per litre of water.

Protection of water quality is also up to individuals, and individual actions are grounded in attitudes to the environment.

Nowadays you're afraid to drink water any place you go. Because all this people they throw a lot of stuff in the water. They don't care about it.

Charlie Dick, Ross River Dena Elder

GOLD RUSH

1896 Gold in the Klondike! - The discovery of gold on Rabbit Creek started the great rush to the Yukon.

1898 Gold on Duncan Creek! This creek in the Mayo area was not staked until 1901. By 1904 there were about 80 placer miners in the district.

1904 Gold in Kluane! Coarse gold was discovered on the Slims River in September 1903, setting off a minor rush that lasted into the fall of 1905.

least as stringent as the effluent limits of the YPA and the MMLERs. The habitat and pollution provisions of the Fisheries Act are enforced by the Department of Fisheries and Oceans, Environment Canada and DIAND's Placer Inspection Unit.

Assessing the Cumulative Effects of Pollution

The impacts of pollution on surface waters can be cumulative. The contaminant 'loading' is the amount of a contaminant discharged to the receiving water. The total loading of contaminants in a stream is the sum of the loadings of all the contaminated effluents. For example, if several placer mines are discharging sediment into the same stream, the sediment loading accumulates. If not settled out, the sediment load persists down the water course.

Recent federal environmental assessment legislation (Canadian Environmental Assessment Act) requires the assessment of cumulative impacts for new development projects. This is clearly a move forward in terms of sustaining ecosystems, rather than just controlling pollution. However, assessing cumulative impacts is a challenge, as there are often many small, difficult-to-measure impacts from the range of activities that occur in a watershed.

The strong concerns many Yukoners feel about protection of Yukon water quality were voiced by Kwanlin Dun First Nation Elder Johnny Smith:

Whatever is in that water will die off in the future if we don't make our move today... I always bring this up – drinking water, it's getting polluted in the Yukon. That has to be cleared up some day. In that area we have to get involved with the other culture, they have to listen to us about our land and our water. Another 50 years from now, maybe this water won't be any good if we don't say something.

Whalers Overwinter on Herschel Island

Commercial whaling began at Herschel Island; by 1894, 15 whaling ships and 1000 men overwintered at Herschel. From 1890 to 1915, about 1500 bowhead whales were harvested. An estimated 29,000 to 40,000 Porcupine caribou were killed to feed the

4 *The Mariner's Museum*

Chapter 3 Land

The Yukon is in the extreme northwestern part of Canada in the Canadian Cordillera, a mountainous region with much of its land above the treeline. The Yukon includes the islands within 32 km of the Beaufort Sea shoreline. Of its 482,515 km^2 area, 478,034 km^2 is land; 4,481 km^2 is water.

Permafrost is widely spread throughout the Yukon but its thickness increases towards the north. There is as much as 238 metres of continuous permafrost in the Blow River area of north Yukon, compared to only two metres of discontinuous permafrost in the southern Teslin area. Permafrost forms in soil or rock that remains at or below zero degrees Celsius for two or more years.

Due to the rain shadow created by the St. Elias Mountains, the northern and west-central portions of the Yukon were not glaciated during the last Ice Age. This led to the formation of Beringia, an ice-free corridor that allowed peoples and animals to migrate.

Placer gold deposits escaped the gouging effects of ice in unglaciated parts of the Yukon. The complex Yukon geology is typical of the Cordilleran system, containing areas of mineralization of great interest to the mining sector.

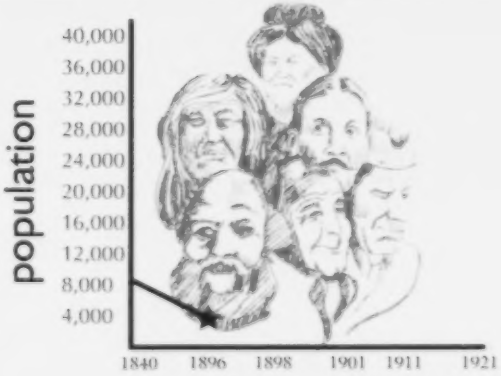
This chapter reviews land use jurisdiction and assesses wilderness and parks and protected areas. Section 3.3 examines the use of land for solid waste disposal, mining, agriculture, transportation, settlement and tourism. The use of the land base for forestry, fish and wildlife is described in Chapters 4 and 5.

Jurisdiction

With the enactment of the Yukon land claim legislation in 1995, jurisdiction over the land is shared by the federal and Yukon governments and the four First Nations having final land claim agreements. Once all land claims are settled, First Nations will manage approximately eight per cent of the land. The Yukon government has jurisdiction over a small percentage of the land, primarily within and adjacent to communities, while most of the land is the responsibility of the Government of Canada.

The Yukon government has the lead role in wildlife management, tourism, recreation, agriculture, rural residential and cottage development, solid waste disposal and transportation. Environmental assessment for projects on federal lands or involving federal money or permits is the responsibility of the federal government, as are land use activities such as those related to mining and forestry. Both the federal and Yukon governments have park systems in the territory.

Under the Yukon land claims agreement, First Nations have authority over settlement land and, where provided for in the agreement, will participate in the management of non-settlement land. By 1997, environmental assessment will be the responsibility of territorial, federal and First Nation governments under a new process outlined in the land claim agreement (the Development Assessment Process). The Yukon North Slope is within the Inuvialuit Settlement Region; environmental assessment and resource management in this region are carried out through joint Inuvialuit and government boards and committees.



GOLD RUSH — 1889

Arthur Harper set up an Alaska Commercial Co. post at Fort Selkirk, head of navigation for sternwheelers on the Yukon River.

If something happen way the heck somewhere else, if some people die or some people get killed or something like that, the owl talk to you. That's how they got their communication them days I guess.
— Archie Roberts, Tr'ondek Hwech'in Elder

3.1 Wilderness

I've stood in some mighty-mouthed hollow
That's plumb-full of hush to the brim
I've watched the big, husky sun wallow
In crimson and gold, and grow dim,
Till the moon set the pearly peaks gleaming,
And the stars tumbled out, neck and crop;
And I've thought that I surely was dreaming
With the peace o' the world piled on top.
(Robert Service, from The Spell of the Yukon)

To the world outside the Yukon, wilderness has been associated with the territory since the Gold Rush and the poetry of Robert Service. At the turn of the century, Service marvelled at the beauty of the Yukon's wide spaces. However, at that time many in Western society viewed wilderness areas as boundaries to push back or overtake – hinterlands to turn to human advantage. Now, at the end of the century, society's view towards wilderness is in flux. Some people continue to see wilderness as a resource in endless supply available for development. Others believe the use of the remaining wilderness area should be monitored and that land uses that affect wilderness areas should be restricted or managed.

Wilderness Mapping Project

For this report, the amount of wilderness area in the Yukon was estimated to use as a baseline against which to measure changes in the future. A subcommittee of the Yukon State of the Environment Steering Committee adapted the mapping and analysis process from a methodology used by the BC Ministry of Forests.[1]

The underlying assumption of the mapping project was that most types of development (roads, mines, settlements) are not compatible with wilderness. Developments affect their surroundings beyond their actual location. At some distance from a development, the effects of the activity are no longer apparent and the area can be

Wilderness – What's In A Name?

Our cultural background shapes our view of wilderness. Imagine seeing the Yukon through the eyes of a visiting tourist. The sight of a pristine valley may bring feelings of awe. Such a boundless landscape can be overwhelming. Now picture the same scene from the perspective of a native Yukoner. This valley may have been visited by scores of ancestors. It could be rich in stories and place names passed on to each generation. Both viewpoints may recognize that the area is special in an ancestral sense – as land that is pristine and untouched by modern technology. Wilderness is also affected by time. In the case of past human use, wilderness values increase with time and the diminished evidence of human activity.

But what name do we give these special areas? The definition of wilderness set out in the Yukon Environment Act is: ***Wilderness means any area of the Yukon in a largely natural condition in which ecosystem processes are largely unaltered by human activity or in which human activity has been limited to developments or activities that do not significantly modify the environment, and includes an area restored to a largely natural condition.***

Some aboriginal languages, on the other hand, lack a word for wilderness. As Chief Joe Johnson of the Kluane First Nation remarked at a recent conference: ***I don't know where the word wilderness is coming from. Why is it wilderness when I feel comfortable when I go back there? What segment of the population calls this area wilderness when it's not to me and my people?***

While the word 'wilderness' may have different connotations for different groups or cultures, there is a common reverence for the beauty of undisturbed lands and the solitude offered by wilderness areas.

1896 GOLD RUSH

Strike on Rabbit Creek!

1896 Placer gold found on Rabbit Creek (renamed Bonanza Creek). The discovery by Skookum Jim (Keish), Dawson Charlie (Káa Goox), Kate Carmack (Shaaw Tlàa) and her husband George, sparked the great rush to the Klondike.

Yukon Archives/Vancouver Public Library Coll.

considered wilderness again. For the purpose of this study three land categories have been identified: 'developed', 'natural' and 'wilderness'. The 'natural' category is the transition area between 'developed' and 'wilderness'.

The next step was to determine the amount of land in each of these three categories. How far must you travel from a mine or a road before you reach an area that is relatively natural? How much further must you travel before you reach wilderness? It was decided that the size of the 'developed' and 'natural' categories should vary depending of the type of development (major developments such as mines should have more of the land around them classified as 'developed' or 'natural' than minor developments such as trails). The types of developments mapped are defined in Table 3a.

The mapping and analysis process had some limitations. First, limited resources and lack of records of some types of land uses meant that all developments could not be mapped. Seismic cut lines, small placer mines, some mineral exploration, winter roads and isolated dwellings or grazing lands are examples of land use activities omitted from the mapping exercise. As a result, the 'wilderness' category includes some development activity.

A second limitation involves the determination of the category sizes. There is considerable subjective judgement in defining the size of 'developed' and 'natural' categories around each type of development. For example, as many Yukoners know, it is possible to be only a few hundred metres from a road yet, if the bush is thick, the road is not noticed. In this case, using eight kilometres as the width of the 'natural' category, or even one kilometre, may *underestimate* the extent of wilderness. In alpine areas, where sight lines are not restricted by vegetation, the width of the 'natural' category may *overestimate* the amount of wilderness.

The model used to map wilderness is based on plotting land use activities. There are drawbacks to this approach. Consider Mayo Lake. Dam construction affected only a small land area but the effect on the salmon run was significant. The upper watershed was blocked to migrating salmon. This ecosystem disturbance is not revealed by the minor land use activity and might be judged as wilderness. There are other examples more global in scale. The ecological changes brought about by the long-range transport of contaminants are not

Wilderness – A Global View

There is a common-sense relationship between the world's human population, which is increasing exponentially, and the shrinking amount of undeveloped land. Larger populations put more pressure on land for a variety of uses such as agriculture, housing, transportation corridors and resource extraction. As a result, many jurisdictions are assessing the extent of their wilderness reserves. Australia, for example, is completing a National Wilderness Inventory program and, within Canada, British Columbia carries out wilderness inventory as part of forest management.

The World Resources Institute prepared a rough global estimate of wilderness areas by using large scale U.S. Defense maps. These maps[2] plot roads and other development sites (but may ignore agricultural and logging activities). What do the results show?

Global scale: 26% (not including Antarctica).
Europe: 3%
North and Central America: 41%
Yukon: 80% (using the analysis in this report, Figure 3.1)

Benefits of Wilderness

- **Ecological value:** Intact areas of wilderness preserve biodiversity.
- **Psychological value:** Wilderness may help satisfy several human emotional needs.
- **Economic value:** A world wide industry has sprung up to meet the demands of 'ecotourism' and this brings direct economic benefits.

GOLD RUSH 1898

1898 April 27 ...We have our logs cut and peeled, ready for sawing as soon as the saw pit is ready, which will be tomorrow. . . There are a dozen or more tents in this camp and thousands scattered along the shores between here and the head of Lindeman. The timber is not good anywhere in this country, and what there is will soon disappear at the present rate.
— Alfred McMichael, Detroit photographer, at Lake Bennett, on his way to the Klondike goldfields.

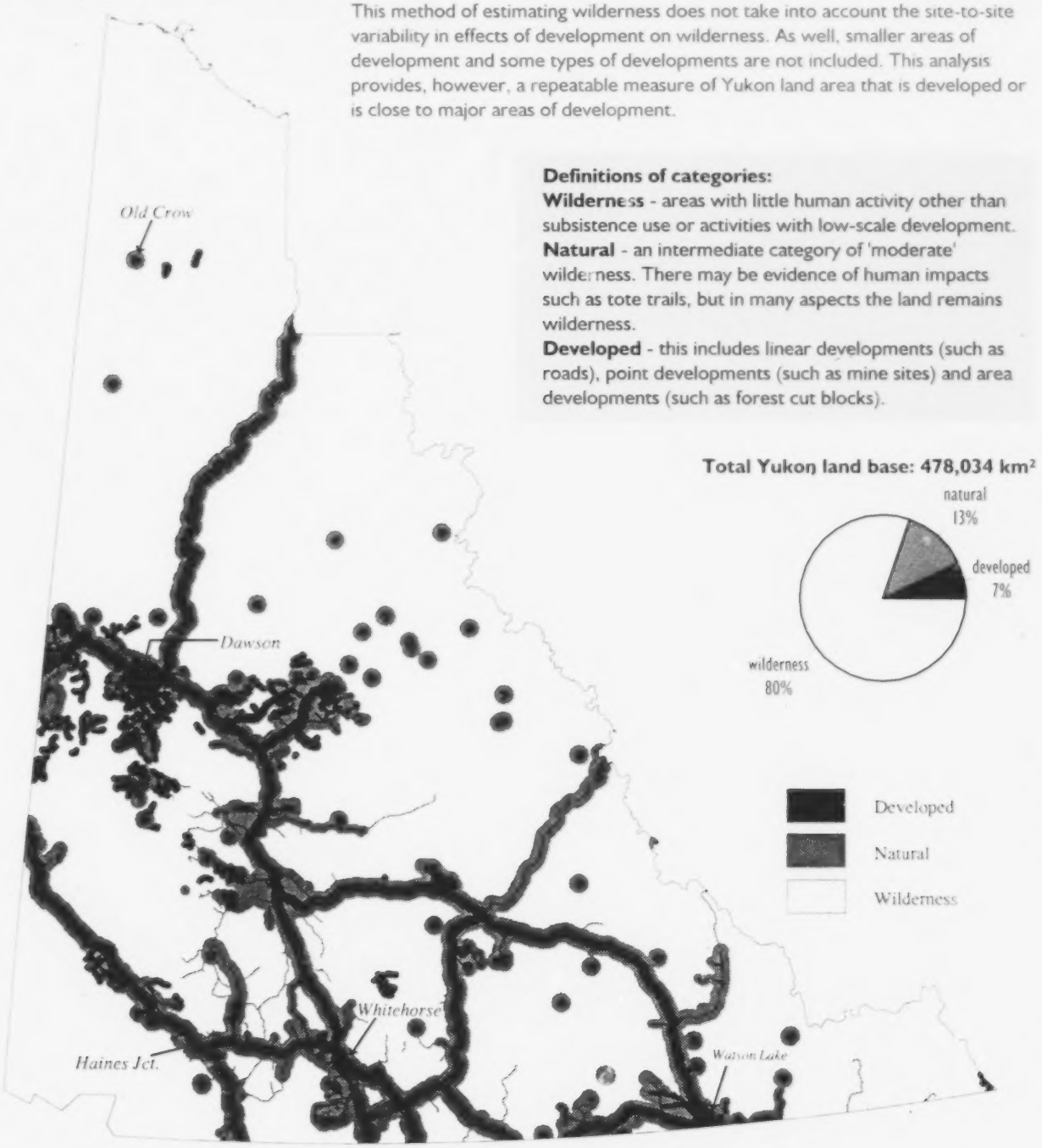
Yukon Archives/J. Greenbank Coll.

Figure 3.1
Wilderness areas of the Yukon

To estimate the quantity of wilderness, land influenced by development was subtracted from the total Yukon land base. Developments were mapped and land was categorized according to the distance from the centre of development.

This method of estimating wilderness does not take into account the site-to-site variability in effects of development on wilderness. As well, smaller areas of development and some types of developments are not included. This analysis provides, however, a repeatable measure of Yukon land area that is developed or is close to major areas of development.

Definitions of categories:
Wilderness - areas with little human activity other than subsistence use or activities with low-scale development.
Natural - an intermediate category of 'moderate' wilderness. There may be evidence of human impacts such as tote trails, but in many aspects the land remains wilderness.
Developed - this includes linear developments (such as roads), point developments (such as mine sites) and area developments (such as forest cut blocks).



Technical notes:

development type	highway	4X2 road	4X4 road	trail	mine	hydro	placer	forestry
developed category width (km)	0-5	0-1	0-1	none	0-5	0-5	0-2	0-2
natural category width (km)	>5-10	1-8	1-5	0-1	>5-10	>5-10	>2-4	>2-4

Natural areas less than 1000 hectares (10 km²) were lumped into the developed category, while wilderness areas less than 5000 hectares (50 km²) were lumped into the natural category.

revealed in this wilderness mapping project. Again, some human activities can have far-reaching effects that may appear unexpectedly in wilderness areas.

Wilderness Lands

The Yukon has vast areas of undeveloped land. Using the criteria described above, approximately 80 per cent of the territory is within the 'wilderness' category (Figure 3.1). It is clear from the map that most areas of development are clustered along major roads. There have been several waves of development in Yukon history and road construction has been the catalyst for many of the land uses locating in wilderness areas. The extent of change in the road network is revealed in the maps showing 1945 and 1995 road network systems (Figure 3.14, Section 3.3).

Yukon wilderness comes in different sized blocks. If these pristine areas are to help preserve biodiversity, the sizes of these blocks must be considered. Conservation biologists now believe that many animal populations are composed of a set of smaller, interbreeding subpopulations. The health of the overall population, in terms of numbers and genetic variability, depends on free movement of animals between subpopulations. If wilderness areas are large enough to include many of the smaller subpopulations, then the population has a strong probability of long-term survival. If the habitat of the animal in question is subdivided by development, the viability of the population may be reduced, particularly if human-built structures inhibit wildlife movement.

Developments that spring up in patches can lead to habitat fragmentation and, over time, this can have unpredicted effects on populations. There are limits to how small a wilderness area we can protect and still ensure that biodiversity is sustained.

We can guard against fragmentation in two ways:

- maintain the integrity of wilderness ecosystems by careful land management; and,
- recognize the cumulative effects of incremental development.

This analysis provides only an initial Yukon-wide estimate of wilderness. Finer scale analyses may be possible in the future as more land use information is computerized or as remote sensing information becomes less expensive. A more sophisticated wilderness model would incorporate variations in effects of development in different types of terrain and would take into account differences in the way development is carried out.

Table 3a
Definitions of development used for mapping

Roads: mapped and classified as all weather highways, two-wheel drive roads, four-wheel drive roads or trails. Winter roads were not mapped.

Mines: defined as operations (whether active or abandoned) that had produced more than 500 tonnes of ore. There is no comprehensive data base of land disturbed by mining. The Yukon Minfile was used to identify major exploration sites and these were entered as point data.

Major Hydro Operations: flow structures were mapped; however, power lines and natural lakes used as reservoirs (e.g. Mayo and Aishihik Lakes) were not mapped.

Placer Mining: operations and leases in good standing as of 1991 were mapped. The actual riverbed or creek that was staked was mapped. It was not possible to map the actual land use impacts associated with each claim.

Major Forestry Operations: defined as sites where multiple permits for logging exceeded 15,000 m^3, or where historical and current fuelwood harvesting exceeded 15,000 m^3.

Settlements: included with the road mapping.

The Seasonal Round

First Nations people in the Yukon moved from place to place during the year to trade, hunt, fish and gather food.

3.2 Protected Areas

Protected areas maintain biodiversity, protect wildlife and watersheds, preserve unique, natural, scenic, historic and cultural areas, preserve the genetic diversity of species, and preserve wilderness. Parks and other types of protected areas in the Yukon may be established by federal agencies (Parks Canada or the Canadian Wildlife Service), or through three Yukon government agencies (Parks and Outdoor Recreation, Wildlife and Heritage branches). As well, protected areas may be established through special federal legislation such as land claims agreements. Yukon protected areas are shown in Figure 3.2.

While the federal Green Plan recommends that Canada set aside 12 per cent of its total land area for parks, the objectives of protecting biodiversity or of establishing a system of parks representative of the ecological diversity of the Yukon may not be fulfilled by meeting an arbitrary land quota.

A more important provision in terms of the development of parks and protected areas across Canada is the agreement between the federal, provincial, and territorial governments to complete a system of representative parks in each jurisdiction by the year 2000.

Non-government agencies and First Nations play a key role in establishing parks and protected areas. Organizations such as the World Wildlife Fund identified areas in need of preservation across Canada and, in the Yukon, First Nations pressed for the designation of Special Management Areas under the Yukon land claim to protect areas of cultural and environmental significance.

Table 3b
IUCN Classification of protected areas

CATEGORY I	Strict Nature Reserve/Wilderness Area
CATEGORY II	National Park
CATEGORY III	Natural Monument
CATEGORY IV	Habitat/Species Managed Area
CATEGORY V	Protected Landscape/Seascape
CATEGORY VI	Managed Resource Protected Area

The National Parks System Plan guides Parks Canada in establishing parks. Under this system, one natural region in the Yukon is not currently represented by a national park and Parks Canada has identified two candidate areas for further assessment.

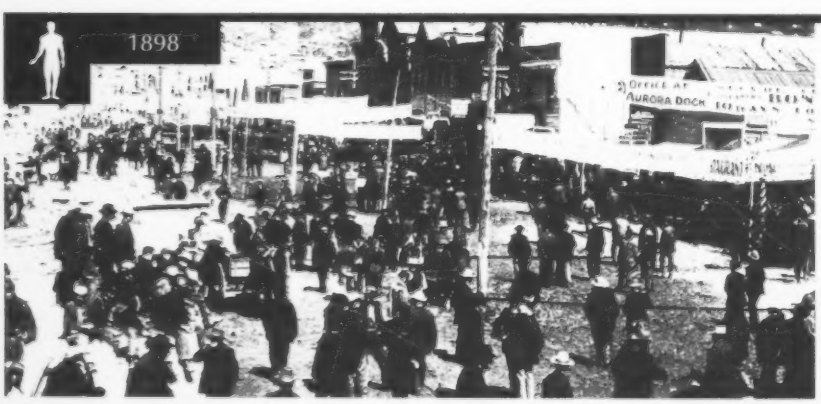
The Yukon Parks System Plan[1] guides the establishment of a system of parks representative of the ecological diversity of the Yukon. Ecoregions will be used by the Parks Branch, Government of Yukon, as the basic geographic units for selecting areas of natural, unique and heritage value.

Protected areas in the Yukon range from relatively small ecological areas to extensive wilderness preserves. Some reserves in the Yukon may have strict provisions for preservation; others only include provisions to limit wildlife harvesting.

The Commission on National Parks and Protected Areas has been established under the International Union for the Conservation of Nature (IUCN). It has developed a system for classifying protected areas on a worldwide basis (Table 3b). The IUCN is an international organization based in Geneva, Switzerland. It has approximately 800 members including states, countries, agencies and individuals.

The objective of the IUCN is to encourage societies throughout the world to conserve the integrity and diversity of nature. It is also committed to ensuring that any use of nature is equitable and biologically sustainable. The classifications for protected areas used world wide are generally accepted by most governments.

Protected areas, as classified under the IUCN system, are unique natural areas, cultural/historical areas and habitats where industrial and extractive uses are not permitted. Protected areas are managed for conservation, c ication, interpretation,

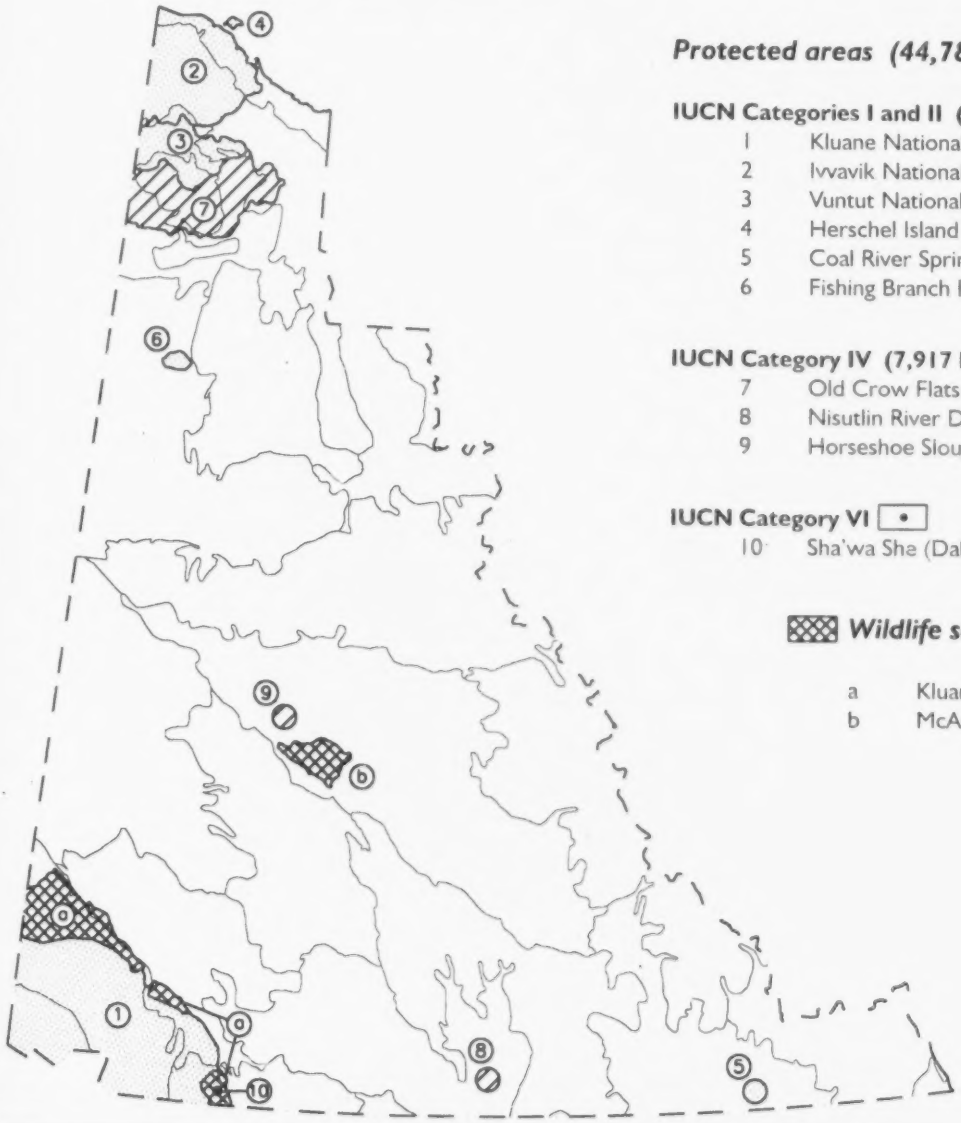


Yukon Archives/Hegg Coll.

An estimated 30,000 people live in Dawson City, with 40,000 in the territory.

Figure 3.2
Sanctuaries and protected areas

The classification for protected areas is based on the International Union for the Conservation of Nature (IUCN) definitions of protected areas (Table 3a). Six of the Yukon's 23 ecoregions (outlined on the map) have one or more protected areas. The two sanctuaries, where the only protection is hunting restrictions, are not considered protected areas following the IUCN classification system.



Protected areas (44,787 km²)

IUCN Categories I and II (36,869 km²)

1 Kluane National Park (22,015 km²)
2 Ivvavik National Park (10,170 km²)
3 Vuntut National Park (4,387 km²)
4 Herschel Island Territorial Park (116 km²)
5 Coal River Springs Territorial Park (16 km²)
6 Fishing Branch Ecological Reserve (165 km²)

IUCN Category IV (7,917 km²)

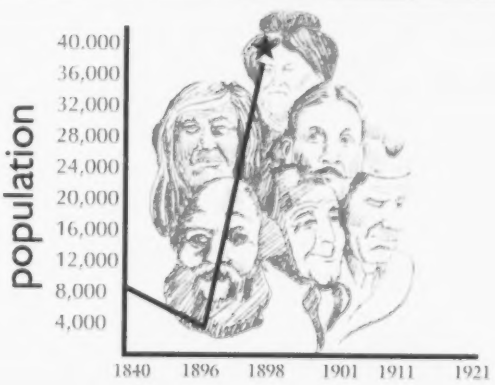
7 Old Crow Flats (7,785 km²)
8 Nisutlin River Delta National Wildlife Area (53 km²)
9 Horseshoe Slough (79 km²)

IUCN Category VI

10 Sha'wa She (Dalton Post)

Wildlife sanctuaries (8,150 km²)

a Kluane Wildlife Sanctuary (6,450 km²)
b McArthur Wildlife Sanctuary (1,700 km²)



GOLD RUSH 1898

Mining Regulations Declared

Placer Mining Regulations and Quartz Mining Regulations declared under Dominion Lands Act. Placer Mining Act declared in 1906. Quartz Mining Act declared in 1924.

3.2 Protected Areas

Protected areas maintain biodiversity, protect wildlife and watersheds, preserve unique, natural, scenic, historic and cultural areas, preserve the genetic diversity of species, and preserve wilderness. Parks and other types of protected areas in the Yukon may be established by federal agencies (Parks Canada or the Canadian Wildlife Service), or through three Yukon government agencies (Parks and Outdoor Recreation, Wildlife and Heritage branches). As well, protected areas may be established through special federal legislation such as land claims agreements. Yukon protected areas are shown in Figure 3.2.

While the federal Green Plan recommends that Canada set aside 12 per cent of its total land area for parks, the objectives of protecting biodiversity or of establishing a system of parks representative of the ecological diversity of the Yukon may not be fulfilled by meeting an arbitrary land quota.

A more important provision in terms of the development of parks and protected areas across Canada is the agreement between the federal, provincial, and territorial governments to complete a system of representative parks in each jurisdiction by the year 2000.

Non-government agencies and First Nations play a key role in establishing parks and protected areas. Organizations such as the World Wildlife Fund identified areas in need of preservation across Canada and, in the Yukon, First Nations pressed for the designation of Special Management Areas under the Yukon land claim to protect areas of cultural and environmental significance.

The National Parks System Plan guides Parks Canada in establishing parks. Under this system, one natural region in the Yukon is not currently represented by a national park and Parks Canada has identified two candidate areas for further assessment.

The Yukon Parks System Plan guides the establishment of a system of parks representative of the ecological diversity of the Yukon. Ecoregions will be used by the Parks Branch, Government of Yukon, as the basic geographic units for selecting areas of natural, unique and heritage value.

Protected areas in the Yukon range from relatively small ecological areas to extensive wilderness preserves. Some reserves in the Yukon may have strict provisions for preservation; others only include provisions to limit wildlife harvesting.

Table 3b
IUCN Classification of protected areas

CATEGORY I	Strict Nature Reserve/Wilderness Area
CATEGORY II	National Park
CATEGORY III	Natural Monument
CATEGORY IV	Habitat/Species Managed Area
CATEGORY V	Protected Landscape/Seascape
CATEGORY VI	Managed Resource Protected Area

The Commission on National Parks and Protected Areas has been established under the International Union for the Conservation of Nature (IUCN). It has developed a system for classifying protected areas on a worldwide basis (Table 3b). The IUCN is an international organization based in Geneva, Switzerland. It has approximately 800 members including states, countries, agencies and individuals.

The objective of the IUCN is to encourage societies throughout the world to conserve the integrity and diversity of nature. It is also committed to ensuring that any use of nature is equitable and biologically sustainable. The classifications for protected areas used world wide are generally accepted by most governments.

Protected areas, as classified under the IUCN system, are unique natural areas, cultural historical areas and habitats where industrial and extractive uses are not permitted. Protected areas are managed for conservation, education, interpretation,

An estimated 30,000 people live in Dawson City, with 40,000 in the territory.

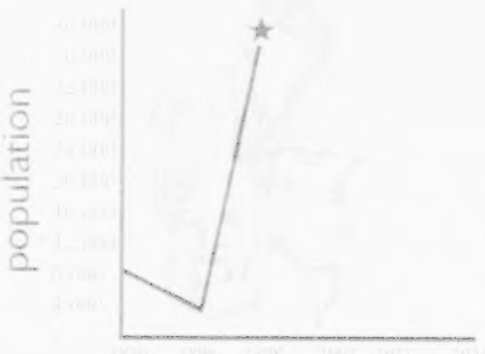
Yukon Archives/Hegg Coll.

Figure 3.2
Sanctuaries and protected areas

The classification for protected areas is based on the International Union for the Conservation of Nature (IUCN) definitions of protected areas (Table 3a). Six of the Yukon's 23 ecoregions (outlined on the map) have one or more protected areas. The two sanctuaries, where the only protection is hunting restrictions, are not considered protected areas following the IUCN classification system.

Protected areas (44,787 km²)
IUCN Categories I and II (36,869 km²)
1 Kluane National Park (22,015 km²)
2 Ivvavik National Park (10,170 km²)
3 Vuntut National Park (4,387 km²)
4 Herschel Island Territorial Park (116 km²)
5 Coal River Springs Territorial Park (16 km²)
6 Fishing Branch Ecological Reserve (163 km²)
IUCN Category IV (7,917 km²)
7 Old Crow Flats (7,785 km²)
8 Nisutlin River Delta National Wildlife Area (53 km²)
9 Horseshoe Slough (79 km²)
IUCN Category VI
10 Shäw Shä (Dalton Post)
Wildlife sanctuaries (8,150 km²)
a Kluane Wildlife Sanctuary (6,450 km²)
b McArthur Wildlife Sanctuary (1,700 km²)

1898



Mining Regulations Declared

Placer Mining Regulations and Quartz Mining Regulations declared under Dominion Lands Act. Placer Mining Act declared in 1906. Quartz Mining Act declared in 1924.

biodiversity and recreation. The historical and cultural sites allow us to look at events that shaped us and our history; the natural landscapes have an aesthetic and spiritual significance for humans; and, the undisturbed areas ensure biodiversity and maintenance of fish and wildlife.

While the protection of natural and historic areas results in a range of cultural and economic benefits from clean water and air to wildlife and maintenance of cultural diversity, one of the measurable economic benefits is derived from the tourism industry (see Section 3.3). According to the 1994 Visitor Exit Survey, enjoyment of scenery was a reason 80 per cent of tourists visited the Yukon.[2]

Natural areas are not viewed solely as regions for humans to use for recreation or to draw tourists to the territory. Increasingly, there is an understanding that protected natural areas have an intrinsic value beyond human use.

Most of the Yukon's protected areas fall within categories I and II – strict nature preserve or national park, with 36,869 km^2 (7.6 per cent of the Yukon) within these categories (Figure 3.2). Categories I and II are protected for research, for protection of wilderness and ecosystems, and for recreation. Kluane, Ivvavik and Vuntut National Parks, Herschel Island Territorial Park and Coal River Springs Territorial Park are designated as categories I and II under the IUCN system. Kluane and Alaska's Wrangell St. Elias National Park were the first international sites to be jointly nominated for protected status. Additions by British Columbia and the U.S. National Parks Service have expanded this World Heritage Site to what may be the largest international protected area in the world.

Old Crow Flats, Nisutlin River Delta National Wildlife Area and Horseshoe Slough Habitat Protection Area fall under category IV of the IUCN system. Sha'wa She (Dalton Post) is within category VI. There are no parks and protected areas in categories III and V. Two wildlife sanctuaries, Kluane and McArthur, which have hunting restrictions but no habitat conservation, are not listed as protected areas following the IUCN classification system.

Total land classified as protected under the IUCN system is 44,787 km^2 or nine per cent of the Yukon. This is only three per cent less than the Canadian goal for protected areas. However, because protected areas represent only six of the 23 Yukon ecoregions, the existing system does not meet the objectives set out in the Yukon Parks System Plan, the Tri-Council Statement of Commitment of 1992 (signed by federal and provincial/territorial ministers of wildlife, environment and parks) or the World Wildlife Fund's Endangered Spaces Campaign. These objectives can be met with the completion of the system of territorial parks if there are provisions to fully protect the natural environment of these areas.

3.3 Land Use

The Yukon environment has remained pristine compared to southern regions of Canada, but the encroachment of human activities evident in more industrialized areas may, over time, be repeated in the North. This section of the report describes land use activities including mining, waste disposal, agriculture, transportation, settlement and tourism.

Mining

Mining forms an important part of Yukon history and present-day economy. For many Yukoners, mining is also a lifestyle choice. Prospecting and placer mining in particular offer opportunities to work 'in the bush' for at least part of the year. Mining is also one of the Yukon's major land uses, including access road construction, exploration and mineral extraction.

While much of the impact on the environment from mining activity is transitory, exploration and mining have transformed the landscape in some areas. Major effects can be seen in the placer areas of the Klondike; on a smaller scale, other effects include road development and the abandonment of equipment and camp refuse at exploration sites.

1898 GOLD RUSH

June 21 At last we are in the mecca of all gold seekers. We arrived yesterday, about noon. Luckily we stopped about 10 miles out and cut some wood to bring with us. It is exceedingly scarce here and men pack it on their backs a long distance. It is very expensive to buy.
— Alfred McMichael

Yukon Archives/Univ. of Washington Coll.

Over the past 10 to 20 years, many controversial issues in the Yukon have revolved around mining and environmental regulation. Many people in the mining industry are concerned about increased levels and complexity of government regulation and the accompanying additional expenses and delays. Many other Yukoners have been concerned about the regulatory regime's lack of capacity to protect the environment from certain mining-related impacts. One of the most difficult issues to resolve has been the regulation of land use activities on mining claims and leases. Activities on claims and leases are currently unregulated unless a water licence or surface lease is required. Amendments to federal legislation to enact land use regulations are now under development.

The Yukon Mining Industry

Prospecting and exploration for hard rock or quartz minerals has had a long history in the Yukon. Each season, the territory is explored for a variety of minerals like gold, silver, copper, platinum, nickel, coal, lead and zinc. The degree of activity depends on world market prices, demand for minerals and the investment climate. Exploration activity is also influenced by local discoveries or the availability of new geological maps. Figure 3.3 shows the fluctuations in mineral exploration spending over the past 20 years.

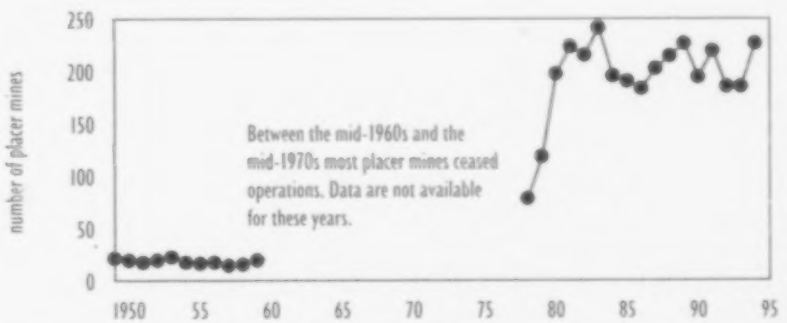
Yukon placer gold deposits contribute up to five per cent of Canadian gold production. The number of active placer mines increased greatly in the late 1970s due to a sharp rise in the price of gold and has remained at around 200 since 1980 (Figure 3.4). The value of placer gold and hard rock mineral production over the past five years is shown in Figure 3.5. Recently-operated mines and mines in the development stage are described in Sections 6.3 and 6.5.

The mining sector's contribution to the Yukon economy and labour force since the mid-1980s is shown in Figure 3.6. The total Gross Domestic Product of the Yukon is linked to activity in the mining sector. The influence of shutdown periods at the Faro mine (1982–1985 and 1993) can be seen in the total GDP.

When mining or exploration companies abruptly pull out of the territory because of low world

Figure 3.3
The Yukon mineral exploration industry

Figure 3.4
Active placer mines, 1949-1994



Dams of cribwork filled with stones, flumes and sluice-boxes lay across our path; heaps of tailings glistened in the sunlight beside yawning holes with windlasses tumbled in; cabins were deserted — the whole creek wherever work had been done, was ripped and gutted. Nothing but fire and flood is so ruthless as the miner.
— Tappan Adney, Bonanza Creek.

Metropolitan Toronto Reference Library

Figure 3.5
Mineral production, 1990-1994

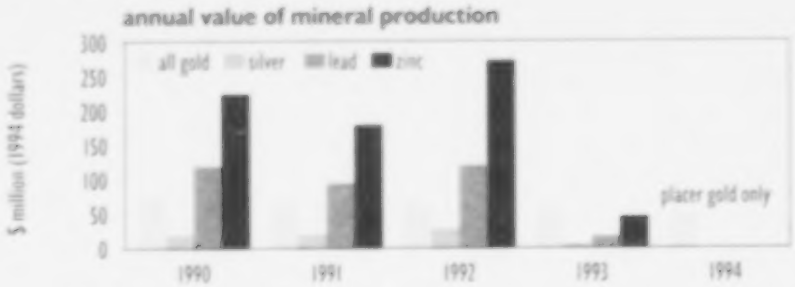
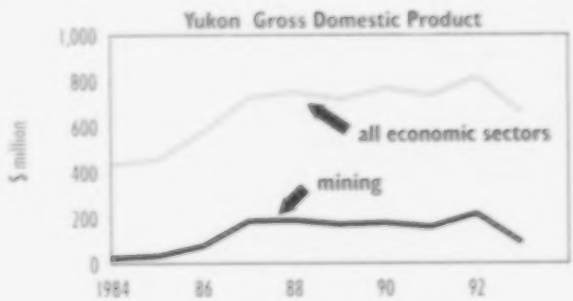
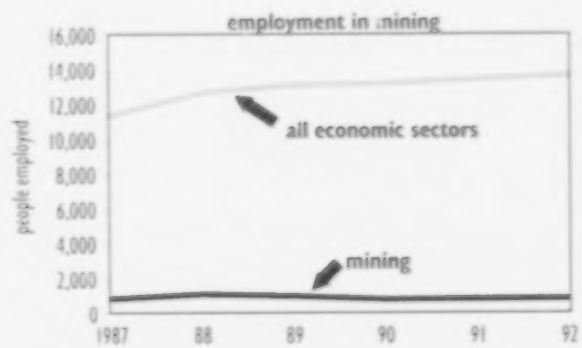


Figure 3.6
Mining sector Gross Domestic Product and contribution to employment in the Yukon

The Gross Domestic Product (GDP) for mining varied between 6% and 26% of the Yukon's total GDP from 1984 to 1993.



Mining employed between 6% and 9% of the Yukon labour force between 1987 and 1992. This is only direct employment; jobs in related sectors also depend on mining.



prices, the decommissioning of their operations is often inadequate. The federal government is now in the process of assessing and cleaning up abandoned mines and mine exploration camps that were 'orphaned' when their operators left and allowed their claims and leases to expire (see Section 6.3).

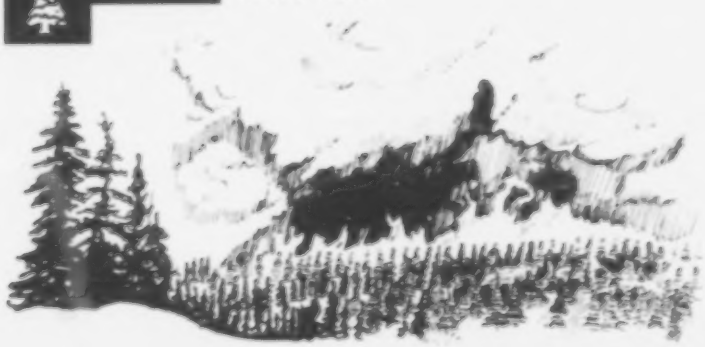
Some mining companies are voluntarily cleaning up their own old sites or those close to their properties. Noranda has cleaned up its old exploration sites on claims throughout the Yukon. In the Bonnet Plume, Pamicon and Westmin have flown out fuel barrels left from oil and gas exploration in the 1970s.

Impacts on the Land

In 1994, 12,360 km^2 of land (2.5 per cent of the Yukon) were held by claims in good standing. This included placer, quartz, iron and mica, and coal mining claims. The level of activity and the impacts of developments vary considerably.

Roads to exploration sites and camps have contributed to the fragmentation of large portions of the Yukon. Mining districts with a long history of activity, such as the Klondike, Faro and Carmacks areas, have a denser network of roads. Roads crisscross these areas from floodplain to high alpine tundra and open up a range of ecosystems to hunters, visitors and other prospectors long after the initial developer has left the area.

1898 GOLD RUSH



Fire!

To get rid of mosquitoes and increase moose browse, some First Nations people would burn a forested area where they were going to settle.

Around Dawson City, fire was regularly used to kill trees and make for a dry timber cut the following year. This was accepted until 1906 when an arson case before the courts eliminated the practice.

Exploration activity leaves its mark. Cat trails, all-terrain roads, trenches and stripped areas are normally abandoned without any reclamation work. In some areas and terrain types – for example, cuts and tailing piles in some placer mines in the Klondike and Mayo areas – disturbed areas stabilize and vegetation is naturally re-established within five to 10 years. At other sites, such as high alpine trenches excavated in rock and coarse overburden piles, hardly any vegetation growth has reappeared even after 40 years. When the surfaces are left without vegetation for a long period of time, processes such as erosion, slumping and permafrost degradation affect the land.

There are no records of the amount of Yukon land disturbed by mineral exploration. Reports outlining exploration activity are filed annually for assessment credit, but reporting all work done is not compulsory. Major exploration programs often report only on the work required to maintain the mineral claim in good standing. An indication of the annual level of activity can be gained from examining these claim assessment files. From 1985 to 1988, a total of 501 annual exploration programs were carried out across the territory. Of these, 194 involved trenching and 165 involved drilling. Although there is no requirement for land reclamation, a few companies have voluntarily backfilled trenches or reseeded disturbed lands.[1]

Placer and hard rock mines have the following types of impacts on the land:

- disturbance of land, affecting vegetation and wildlife habitat and limiting other land uses such as traditional use, hunting, trapping and recreation;
- erosion of soils and slumping or other slope instability problems;
- direct disturbance of streambanks and streambeds; and,
- introduction of non-degradable materials, such as equipment, buildings, mills, refuse, fuel and drilling fluids which are often abandoned on site.

In recent years, the mining industry's increased awareness of environmental issues, along with improved environmental assessment and regulation of new mines, have gone a long way towards minimizing impacts and reducing the potential for long-term environmental problems in the Yukon. New operations incorporate decommissioning planning and environmental monitoring into their proposals. Financing for abandonment is now addressed during the early stages of mine development.

Older mines, like those at Faro and in the Keno-Elsa area, have accumulated problems from past mining. Fixing up old problems can be very expensive: estimates of costs for eventual decommissioning and long term maintenance of the Faro mine site are in the $100 million range.[2]

Regulatory Environment

Current Legislation

Several pieces of federal legislation have some bearing on mining and land use.

- **Yukon Placer Mining Act** allows the staking of placer claims and prospecting for placer gold.
- **Yukon Quartz Mining Act** allows the prospecting for and the mining of minerals.
- **Canadian Environmental Assessment Act** requires the environmental impact assessment and review of development projects needing federal approval or taking place on federal land. Applies to all mining projects requiring a water licence.
- **Territorial Lands Act** regulates land use activities. This act does not apply to mineral claims. The mining industry is subject to this legislation when building access roads to mineral properties or when securing surface tenure.
- **Yukon Waters Act** regulates water usage and controls the deposition of waste into Yukon waters. Because what happens to the land affects what is deposited in water, provisions in water licences often contain requirements related to land, such as measures to stabilize waste dumps.
- **Fisheries Act** provides for protection of fish habitat, including regulation of stream crossings.

And Flood!

Dawson City sits on a low flood plain.
It flooded way up, nearly all the streets were flooded, from the front river bank, right up . . . to Seventh Avenue. We travelled around with boats while the flood was on.
— Johnny Baker, Tagish Elder speaking of Dawson City.

Yukon Archives/Vancouver Public Library Coll.

Proposed Legislation

- **Mining Land Use Regulations**
  In 1992 the Yukon Mining Advisory Committee (with members from government, industry, First Nations and the Yukon Conservation Society) released a report to the Minister of Indian Affairs and Northern Development recommending that the placer and quartz mining acts be amended to authorize the regulation of land use activities on mineral claims. Proposed land use regulations have been drafted and mine site reclamation regulations are being developed.
- **Production Licences**
  The Yukon Mining Advisory Committee report also recommended the introduction of mine production licences containing requirements for land reclamation. These licences would be required for mines entering the production phase and would not apply to mineral exploration programs.

Solid and Hazardous Wastes

Imagine the job facing Yukon archaeologists. They search far and wide looking for bone or copper artifacts and with these meagre clues they try to piece together how early inhabitants lived. Now consider the 'clues' we are leaving behind about our own lifestyle. Future researchers will have little trouble determining our habits. We throw away approximately 700 kg of waste per Yukoner each year! In the last 10 years all Canadian jurisdictions have taken steps to reduce garbage production (Figure 3.7). The Yukon government, as a member of the Canadian Council of Ministers on the Environment, has set a target for reducing municipal solid waste by 50 per cent by the year 2000.[3]

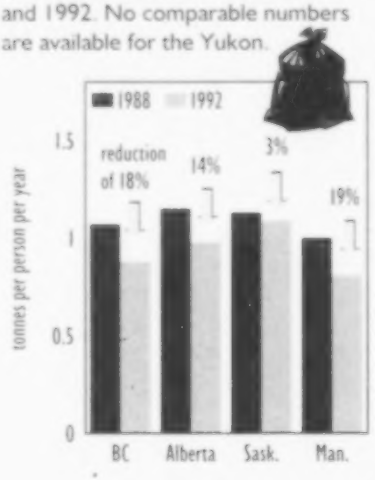
Our communities produce large volumes of solid waste and smaller quantities of special wastes such as solvents, cleaners and waste oil. There are no accurate estimates on the volume of solid wastes produced in the Yukon but some data are available on the composition of this waste stream (Figure 3.8). The types of wastes produced by Whitehorse households are similar to those found in southern Canada.

History of Yukon Wastes: 1940s to 1990s

During World War II, the Alaska Highway, the Canol Road and Pipeline, the airports of the Northwest staging route, and an oil refinery were constructed in the territory. Residue from the Whitehorse refinery resulted in the Marwell tar pit. In 1993, a demonstration project was carried out to determine if either a biological slurry reactor, or a thermal adsorption process could be used to clean up contaminated soils at the tar pit.[4] Both methods proved satisfactory but expensive; no clean-up is planned because of the high cost.

Figure 3.7
Trends in solid waste production in the western provinces, 1988 to 1992

All four western provinces report a decrease in the amount of landfilled garbage per person between 1988 and 1992. No comparable numbers are available for the Yukon.



This period of rapid economic expansion also led to increased production of both solid and hazardous waste. Communities like Watson Lake, Teslin and Whitehorse were unprepared to deal with the influx of workers; facilities to deal with garbage and sewage were put in place in a hurry. One such facility was the McIntyre Creek or Range Road dump at the confluence of McIntyre Creek and the Yukon River in Whitehorse. A large amount of garbage, including hundreds of tires, entered both rivers until the dump was closed in 1975.

1900 TURN OF THE CENTURY

Caribou Blackened the Ice

Before 1910, large herds of caribou roamed the southern Yukon. Southern Tutchone tradition describes caribou so plentiful they blackened the ice at Kluane and Aishihik lakes. One thing that impeded the migrations was the telegraph line. The caribou would not walk under the wires strung across the hills.

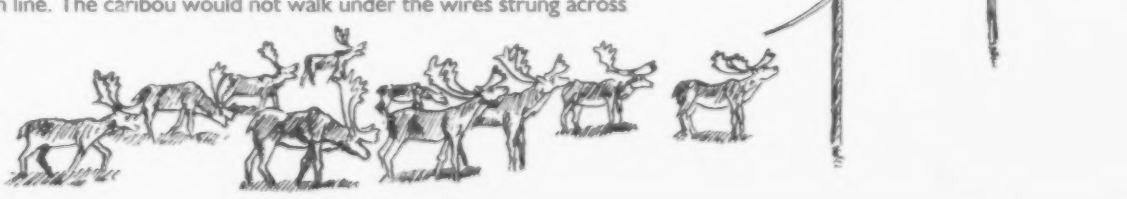
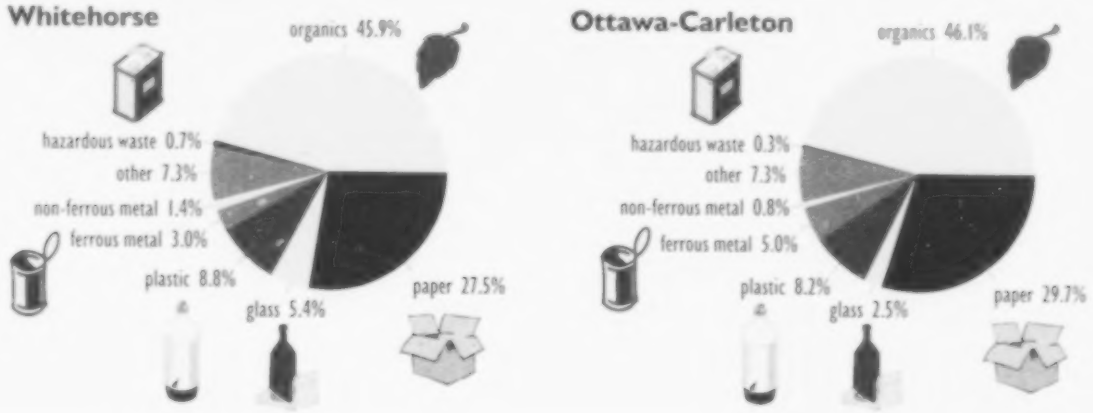


Figure 3.8
Composition of Whitehorse and Ottawa-Carleton residential solid waste

As in other areas of Canada, Yukon's solid waste is composed largely of recyclable and reusable materials. Compostable organic materials constitute a large percentage of residential waste.



Tests have shown that leachate from this dump now has only a minor impact on groundwater at the dump site[5] and no measurable impact on the quality of Yukon River water.[6] However, given the location of the dump and the history of its use, it is probable that in the past contaminants from this dump entered river water and sediments. Tests of sediment cores in Lake Laberge, downstream of the dump, indicate that a PCB spill occurred somewhere in the vicinity in the 1950s.[7] Residents downstream of the dump remain concerned about possible impacts from toxic substances in the Range Road dump.

One of the main persistent toxic chemicals imported to the Yukon was DDT, a pesticide used for mosquito control from the 1940s to the late 1960s. DDT was sprayed onto mosquito-breeding habitat around communities, roadways and pipelines. Barrels of DDT were discovered in 1994 buried at Rainy Hollow, a Haines pipeline station in British Columbia near the Yukon border. No DDT has been found in assessments and cleanup operations of Yukon disposal sites.

Waste Disposal Practices

Most solid waste in the Yukon is disposed of in 25 waste sites located in or near communities. At the majority of sites, unsorted waste is dumped into an excavated trench or natural depression and burned (Figure 3.9). A few communities sort garbage into recyclables, compost and general waste. A few others offer a segregated area for reusable items that can be set aside as a 'free store'. All sites segregate or do not accept waste metals and construction or demolition debris. The majority of the Yukon sites are small and long-term (five-year) cells having a capacity of less than 30 cubic metres.

In addition to the 25 managed sites, there are many abandoned or unregulated garbage dumps in the Yukon.

In recent years, the old view of the environment as a zero-cost receptacle for wastes has been changing. If we adopt a full cost accounting approach we find that waste disposal has many costs:

TURN OF THE CENTURY 1900

Wildlife Legislation

Game was depleted as the population grew. An amendment to the 1898 Yukon Act gave the Yukon power over its wildlife resources. Wildlife legislation restricted hunting.

Yukon Territorial Council, 1909.
Yukon Archives/MacBride Museum Coll.

Figure 3.9
Solid waste disposal sites

Direct Costs

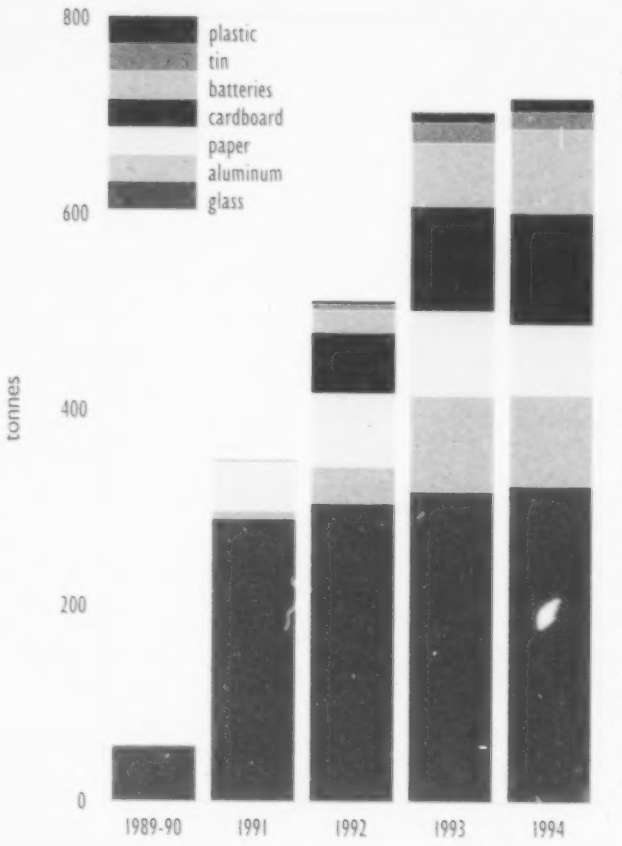
- picking up residential garbage – $25 per tonne
- operating rural waste sites – up to $5,000 per year
- operating the Whitehorse landfill – $325,000 per year
- developing a new 'cell' at the Whitehorse landfill – estimated at $460,000
- developing a rural community landfill – $30,000

Indirect Costs

- air pollution from burning wastes in landfills
- harm to wildlife attracted to dumps, especially bears
- littering caused by paper and plastic wastes blowing away from landfills
- leaching from landfills may contaminate groundwater
- water runoff from landfills may pollute surface waters

The Yukon government follows the "Interim Solid Waste Management Procedures and Guidelines", established in 1990, which set out a minimum standard for the management of Yukon government waste sites.

Figure 3.10
Recyclable materials processed by Raven Recycling



The recovery of recyclable solid waste in the Yukon is possible largely because of the efforts of non-profit societies that operate recycling depots and serve as educators. Raven Recycling in Whitehorse processes recyclables from the city and from outlying communities. In addition, a considerable volume of metals is collected and shipped out of the Yukon by scrap dealers.

Reducing the Waste Stream

How do we decrease the volume of waste we produce? The most effective way is to reduce the amount of waste generated in the first place. We can shop for more durable goods or reject excessive packaging. According to the solid waste inventory done by the City of Whitehorse in 1994, up to three quarters of household solid waste is recyclable or reusable. Some of these materials are thrown out because there is no system for handling them. This situation, however, is improving. Recycling operations have been started by citizens, with government support. All Yukon communities except Old Crow now have access to a non-profit community recycling depot.

Community Recycling

Rural recycling depots ship materials to a central depot in Whitehorse. This depot is operated by Raven Recycling, a non-profit society which began recycling in 1989. It accepts several types of recyclable materials such as aluminum, office paper, newspapers, brown paper bags, tin

Wintertime, people hunted fur, used dog teams. After they came back from Dalton Post, they hunted and dried meat, put up food, berries. They put them in birch bark, they freeze them and put them away. There's no hard times. There used to be caribou there all the time. I remember big herds of caribou. But now, no more.

— Annie Ned remembering Hutshi

(steel) cans, corrugated cardboard, plastic (PET) drink containers, some oil and household batteries. These materials are shipped to Alberta and British Columbia for processing. Refillable beer and cider bottles are sent to the Yukon Liquor Corporation. The volume of material that Raven Recycling accepts has increased annually (Figure 3.10).

Local scrap dealers contribute to recycling efforts by collecting and shipping out reclaimed iron, copper, aluminum and batteries. The governments of Canada and Yukon combined efforts to ship over 500 derelict vehicles south for recycling over the 1994-95 winter.

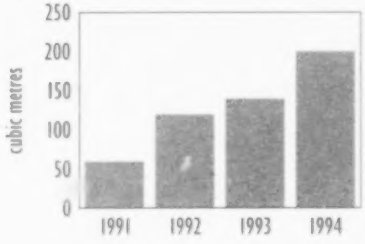
Beverage container deposits now applied to liquor bottles and aluminum cans provide for a high recovery rate of these containers. In the program's first full year of operation (1993 to 1994), 77.7 per cent of containers that fall under the regulations were recouped, based on the sale of over 14 million containers.[8]

Composting

Many Yukon residents compost organic household waste in backyards. Approximately 30 per cent of residential wastes consist of organic matter that can be composted. The Recycle Organics Together Society (R.O.T.S.) began a community composting project for Whitehorse in 1990. The operation is now at the landfill site. The compost is recycled as fertilizer. The landfill operation receives compostable materials such as lawn trimmings, spoiled produce and kitchen waste and converts it to compost. R.O.T.S. has shown the feasibility of composting and its scale of processing has increased each year (Figure 3.11). In some Canadian cities, compost is picked up at curbside. In Whitehorse, residents it drop off, a factor which limits the volume being diverted from disposal.

Figure 3.11
Organic material composted in Whitehorse by ROTS

Almost half of the solid waste entering landfill sites is composed of organic materials, the most easily recyclable type of waste. Composting is increasingly being used as a clean and effective method of recycling organics.



The Yukon Chamber of Mines began a pilot project in 1994 using compost and other organic waste to revegetate part of the abandoned Whitehorse Copper Mine tailings. Nearby residents had complained about dust from the surface of the tailings; no vegetation could grow because of the high pH. In separate one-hectare plots, compost from grass cuttings from landscaping companies and a sod farm, grass cuttings alone, sawdust alone, and a mix of sawdust and grass cuttings were rototilled into the tailings surface area. The plots have been seeded and the results will be monitored.

A Society without Waste

Few people would choose to return to a life without modern conveniences and technological developments, but, many would prefer to live in a society which reduced its waste stream and lived more in harmony with the natural environment. One hundred years ago, Yukon natives lived from the land without leaving behind much more than a few bones, old fireplaces and tent rings marking their occupancy. In pre-industrial society, and more recently in rural areas, people produced their own food, creating very little waste.

Yukon elders who lived on the land recall how everything was used with little or no waste. Materials discarded in earlier times were organic, and through time, decomposed into the earth.

Dick Dickson (Kluane First Nation), recalling the outfitter's life in the 1940s explains: *They had flour sacks and there were hardly any tin cans. Everything else you would burn up, so your campsite would be clean.*

Stella Jim (Champagne Aishihik First Nation) recounted activities 40 years ago: *When we pick*

1900 TURN OF THE CENTURY

Railway Arrives in Whitehorse

The White Pass and Yukon Railway from Skagway to Whitehorse was completed. Lewis Lake near Carcross was accidentally drained during construction causing a tremendous flood (1899). The lake level was lowered 70 feet. Muddy waters stained the headwater lakes all the way to Tagish police post. The Watson River valley was covered in mud from Lewis Lake to Lake Bennett.

Once the railway was built, tons of materials could be moved from tidewater to the goldfields. This allowed large-scale mining to begin.

berries too, we go use that moose stomach. You know, those big moose stomachs there – and you wash it off and you blow it up and dry it. And then, that's your paper bag.

Another elder looks at today's disposal practices and observes: *I see meat in the Faro dump, lots of caribou ribs, moose ribs, caribou hides, moose hides. I see it with my two eyes. If they gave this to the Indians, we would use everything.* (Charlie Dick, Ross River Dena Elder)

The traditional method of diapering babies created no waste. Major landfill sites in Canada deal with approximately 100,000 tonnes of disposable diapers a year. *They used moss for diapers in those days.* (Stella Jim, Champagne Aishihik First Nation Elder)

The hunting and gathering society was phased out with the Gold Rush, but there are lessons to be learned from the way of life that was in harmony with the land and the water.

Hazardous Wastes

Hazardous wastes require extra care at the disposal stage. Special Waste Regulations, enacted by the Yukon government in 1995, set out provisions to protect public health and safety and the environment.

The Yukon annually generates approximately 1,000 tonnes of hazardous waste (Figure 3.12). The largest part is waste oil. Several communities have collection systems to encourage discarded motor oil recycling.

There is no storage facility where all special wastes can be kept prior to shipment out of the Yukon. Companies that produce special wastes must store them on their own premises. However, the Yukon government does maintain a specially equipped marine cargo container in Whitehorse to store 'orphaned' special waste, waste for which no owner can be identified.

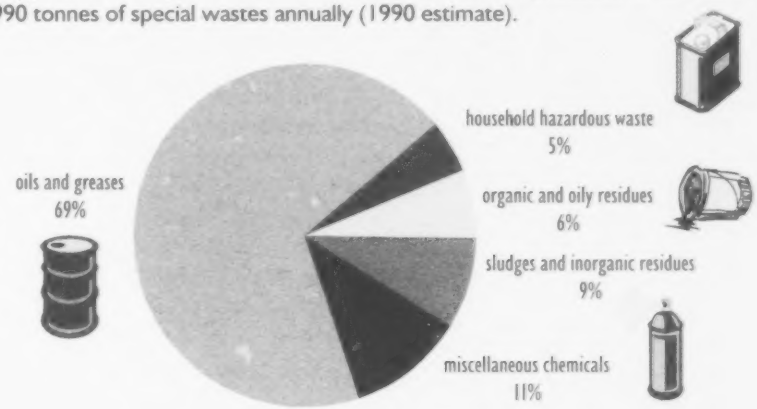
The Yukon government ships special waste out of the territory about once a year. A recent shipment included barrels of contaminated petroleum, hazardous residues, miscellaneous chemicals and 15 barrels of

Tires, Tires, Tires

The fleet of highway vehicles in the Yukon is large in relation to our small population. In May 1995, there were 21,886 private vehicles registered in the Yukon. This works out to approximately two cars for every three people, slightly above the national per capita average. These private vehicles, along with commercial vehicles in the Yukon, wear out thousands of tires per month! The Whitehorse landfill contains over 185,000 tires, and the number of tires entering the landfill is estimated at 11,000–16,000 each year.

Figure 3.12
Hazardous wastes produced in the Yukon

Special or hazardous wastes are the most difficult wastes to manage and pose the most risks to public and environmental health. Currently the only method of handling hazardous wastes in the Yukon is to store them until they can be shipped out to disposal facilities elsewhere. The Yukon produces an estimated 990 tonnes of special wastes annually (1990 estimate).



TURN OF THE CENTURY 1900

Work train at White Pass Summit, 20 May 1899.
Yukon Archives/Barley Coll.

household special waste. This household waste was amassed during special collection days held by Raven Recycling to keep hazardous wastes out of landfill sites.

Many Yukoners are concerned about what old garbage dumps may contain. DIAND is carrying out an inventory of waste sites on public land. Over 800 sites have been identified; most contain building debris, car bodies and household wastes. Of these sites, 331 contained old 45 gallon barrels with 'mystery' contents; 186 of those sites had been cleaned up by the summer of 1995. Yukon First Nations have done much of this work under contribution agreements with government.

Agriculture

Agriculture has been part of the Yukon since the beginning of non-native settlement. Cultivated crops were grown adjacent to fur trading posts from the mid-19th century on, and the Yukon met most of its requirements for vegetables and forage crops during the Gold Rush when most of the Yukon's 40,000 residents lived in Dawson City.

Over the past 20 years farming has increased and locally grown farm products are again available in the Yukon (Figure 3.13). In 1990, the sale of farm products exceeded $2 million. The sale of livestock and animal products accounted for half of this value.

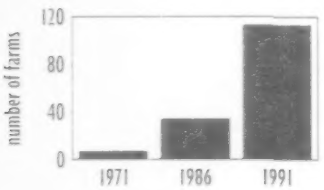
Most agricultural development in the past 20 years has occurred in the greater Whitehorse area on Class Five soils. Agriculture in this area is primarily a lifestyle choice with many part time farmers dependent on employment within the city. Interest in agricultural lands close to major settlements and employment opportunities is expected to continue.

The Yukon government objective for the agricultural program is import replacement. This has been achieved to a degree with respect to local forage production which currently comprises 50 per cent of Yukon consumption. Import replacement in food products is more difficult due to the low cost of imports from the south.

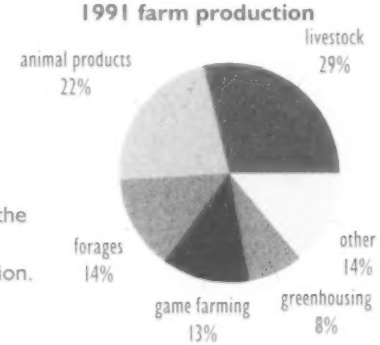
Although a variety of crops can be grown, there are constraints to agriculture in the Yukon. Climate is the most significant. The number of frost free days ranges from approximately 21 in Haines Junction to 75 around Dawson City. Killing frosts may occur in any month of the year. Appropriate land for agriculture is located primarily in the river valleys. The most suitable regions are near Dawson City, Stewart River, south of Stewart Crossing to Pelly River and Carmacks. While the best regions are capable of production of barley, oats, forages and a wide range of vegetables, most agricultural development in the Yukon is on Class Five land, only suitable for forage crops and cool climate vegetables.

Figure 3.13
Farming in the Yukon

The number of farms in the Yukon has increased from 7 in 1971 to 113 in 1991.



1991 farm production



The value of farm production, totalling $2.3 million, includes the reported value of sales and an estimate of on-farm consumption.

1901 TURN OF THE CENTURY

Gold on Duncan Creek!

Gold rush on Duncan Creek, Mayo area. By 1904 there were about 80 placer miners in the district.

Yukon Electrical Company Opens

Originally located on the Whitehorse waterfront, the company supplied electricity to businesses and residences, but only for certain hours of the day.

Hunting Limits Set

First annual limits set at 6 caribou, 2 moose, 2 sheep and 2 goats per hunter; $500 penalty for 'wasting meat'.

In the Yukon, the major impact of agriculture is the conversion of land from natural to developed areas and the related loss of wildlife habitat, subsistence and trapping areas, and public recreation lands. There are conflicting demands for land in the greater Whitehorse area. Most land with agricultural potential close to Whitehorse is either subject to land claim negotiations or has already been allocated. Since land has become increasingly unavailable close to Whitehorse, interest in agricultural parcels is reaching further out into the hinterland where there may be less conflict with recreational use but more potential for impacts on wildlife and subsistence activities (see Settlement, this section).

An estimated 92 km^2, or 1.3 per cent of the Yukon's 6,680 km^2 of arable land has been developed for farming. In terms of the total land area of the Yukon this accounts for only 0.02 per cent. However areas developed for farming are usually valley bottom lands which are limited in the Yukon and are often key wildlife habitat or of high recreation value.

There are approximately 30 km^2 of salt-affected soils in the Takhini, Dezadeash and Yukon River valleys, and the Marsh Lake and Tagish areas. High levels of salts in these soils is a natural condition which can increase if these lands are cultivated. The best use of the land is to leave it undeveloped or use it as grazing land. To date, only 2 km^2 of salt-affected land have been developed into farmland. Land with saline soil will not likely be released for agricultural development in the future, and lands that have been allocated for production are being monitored.

Fish habitat can also be affected by agricultural activities. The most serious impacts are caused by irrigation. Heavy irrigation can reduce streamflow so that fish are affected and fry may be sucked into the system if pipe screening is improperly installed or maintained. Stream crossings or stock watering areas may also destroy fish habitat and excessive use of fertilizers and pesticides are potentially damaging to fish and fish habitat. Through the land allocation review process, biologists assess agricultural applications and advise on ways to prevent degradation of fish habitat.

Currently there are three game farming operations in the greater Whitehorse area. These include wood bison, elk and a commercial game farm with a variety of animals. Although there is no evidence of genetic contamination or disease transmission in the Yukon, the potential for these problems to occur locally has been raised. Game farming operations may also displace wildlife habitat and convert public open space to privately fenced lands. Only 4 km^2 has been allocated for game farming to date.

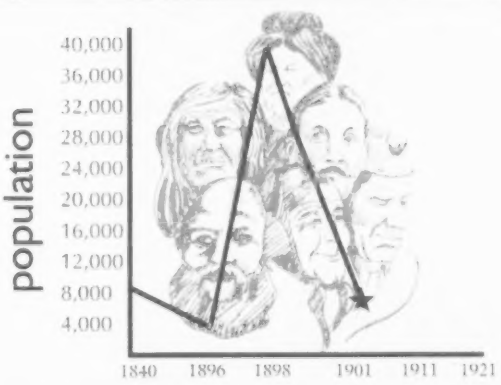
Game farming is regulated under the Yukon Game Farming Regulations enacted in April 1995 pursuant to the Game Farming Policy. The regulations allow for farming of three species: Rocky Mountain elk, muskoxen and wood bison. The regulations address escapement, capture and testing provisions. Game farming is restricted to the greater Whitehorse area. Development of game farms in other areas of the Yukon are subject to consultation with local and regional authorities.

There has been no evidence of soil erosion or pollution from agricultural activities, although there is the potential for soil degradation if land clearing is not carried out in a sound manner. The Yukon Agriculture Branch monitors agricultural practices to prevent soil degradation.

"Agriculture for the 90s", a Yukon government policy, states that lands will be allocated in a way that provides sustainable social and economic benefits from agricultural development while minimizing effects on the environment.

Canadian Initiatives to Promote Sustainable Agriculture

- Quebec and Ontario established provincial targets of a 50% reduction in agricultural uses of pesticides by the turn of the century.
- British Columbia put in place the Agricultural Land Reserve to protect agricultural land from being converted to non-farm use.
- Canada has encouraged economic diversification and improved farm practices in order to halt land degradation and erosion, especially in the prairie farmbelt.



TURN OF THE CENTURY 1902

Something for Our Indians

...tell the King very hard we want something for our Indians because they take our land and game.

— Jim Boss, Ta'an Kwach'an, in a letter to the Superintendent of Indian Affairs in Ottawa.

Transportation

The development of a transportation network results in changes to the land, its resources and the people living off the land. Before the Gold Rush, people travelled by foot, dog team and boats, on trails and by river, leaving little evidence of their passage. During the Gold Rush local roads were developed in the Klondike region and travel through the Yukon was enhanced by construction of the railway from Skagway and development of the river boat system.

The road transportation network in the Yukon began in 1942 with the construction of the Alaska Highway. Prior to that time, there was a winter road from Whitehorse to Dawson City, a road from Mendenhall to Silver City on Kluane Lake, and roads connecting the gold fields in the Klondike and the mining operations at Whitehorse and Keno (Figure 3.14).

The Alaska Highway brought all-weather transportation to the Yukon and new roads were added

Figure 3.14
Roads in the Yukon, 1945 and 1995

There was little road development in the Yukon until the construction of the Alaska Highway from 1942-44. Since that time, all communities except Old Crow have been connected by roads and many spur roads branch off the main highways. In addition to the roads shown on the map, there are numerous tote trails and winter roads which have not been mapped.

1945 Roads **1995 Roads**

1904 TURN OF THE CENTURY

44 Concessions Granted

Under new system, 44 concessions granted. Concessions were government grants allowing the purchase of claims, control of water and timber rights on large land areas for large-scale mining.

each year with access to every community except the village of Old Crow. The First Nation people who lived in remote areas were the most seriously affected. The requirement of schooling forced families to relocate to highway communities, significantly altering the native culture which was closely associated with hunting, fishing and collecting plants. Settlements moved from small camps and villages located close to the hunting and fishing areas along valleys, lakes and rivers to communities along highways.

The highway system has been a catalyst for development over the past 50 years, facilitating large-scale mining operations and assisting in the expansion of the tourist industry. The result has been an increase in the use of natural resources for mining, hunting, fishing and sightseeing.

While transportation is a major part of the Yukon economy, in some cases it has had a harmful effect on wildlife. The influx of military and civilian personnel during the intensive period of construction of the Alaska Highway and the Canol Road resulted in overharvest and depletion of wildlife populations in several areas.

In recognition of the potential for overhunting along the Alaska Highway, the Kluane Wildlife Sanctuary was created in 1943 and a 'no hunting' corridor was established along the Dempster Highway following its construction in the 1970s. Currently, land use permits for new roads and roads which receive government funding are assessed to minimize the potential for damage to the environment.

Settlement

Settlement patterns in the Yukon have continued to evolve with most population growth occurring in the greater Whitehorse area. Since the 1950s, the percentage of the Yukon's population living in Whitehorse has increased from 28 per cent to 68 per cent. If the population of the rural areas surrounding Whitehorse were totalled, the percentage living in the Yukon's capital would be approximately 75 per cent.

The Takhini Valley Case Study

One of the major implications of this shift in population is the development of land around the City of Whitehorse for both agricultural and rural residential use. The Takhini Valley settlement, located 15 km northwest of Whitehorse, is indicative of a pattern of land use in the fringes of many North American cities.

The portion of the Takhini Valley undergoing development extends from the Klondike Highway bridge over the Takhini River to Stoney Creek, 40 km to the west. This part of the valley has experienced rapid rural residential and farmland expansion over the past 10 years (Figures 3.15 and 3.16). In 1975 there was less than a hectare of rural residential land developed; now there are over 130 rural residences.

Of the 92 km^2 of developed farmland in the Yukon, almost 50 per cent is located in the Takhini Valley. In addition, there are applications for agriculture and grazing lands for approximately 30 km^2 of land in the valley, and fairly extensive land claim selections. Although pending agricultural applications will not all be approved and not all native settlement lands will be developed, the potential for continued conversion of natural areas to settlement use and incremental increases in population density remains.

A rural lifestyle and lower taxes likely attracted urban dwellers to the Takhini Valley. This migration followed the availability of rural homesites in the valley and continued in the 1980s when an agricultural land allocation program was implemented.

At the same time, restrictions on the disposition of spot rural residential land in the early 1980s directed pressure at the agricultural land program and, for a period of time, the easiest way for applicants to obtain a parcel of land was to apply for agricultural land. The use of the agricultural land program to obtain a rural homesite has been partially resolved by ensuring that a supply of rural residential lots is available and through implementation of provisions of the Yukon Agriculture Policy.

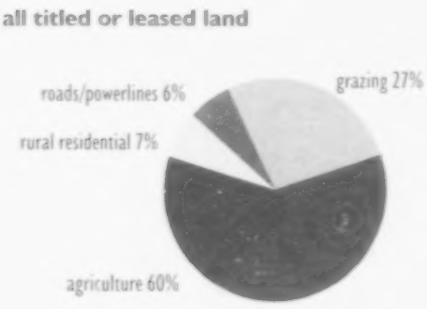
Market Hunting

An estimated 600 moose and 2300 caribou killed to feed Dawson City residents.

Yukon Archives/Whitehouse Coll.

Figure 3.15
Land use in the Takhini Valley, 1994

Only titled or leased land is included. Native settlement lands and government reserves are not included. Land used for fuelwood cutting, subsistence and recreation, which occur on crown land, has not been tabulated.



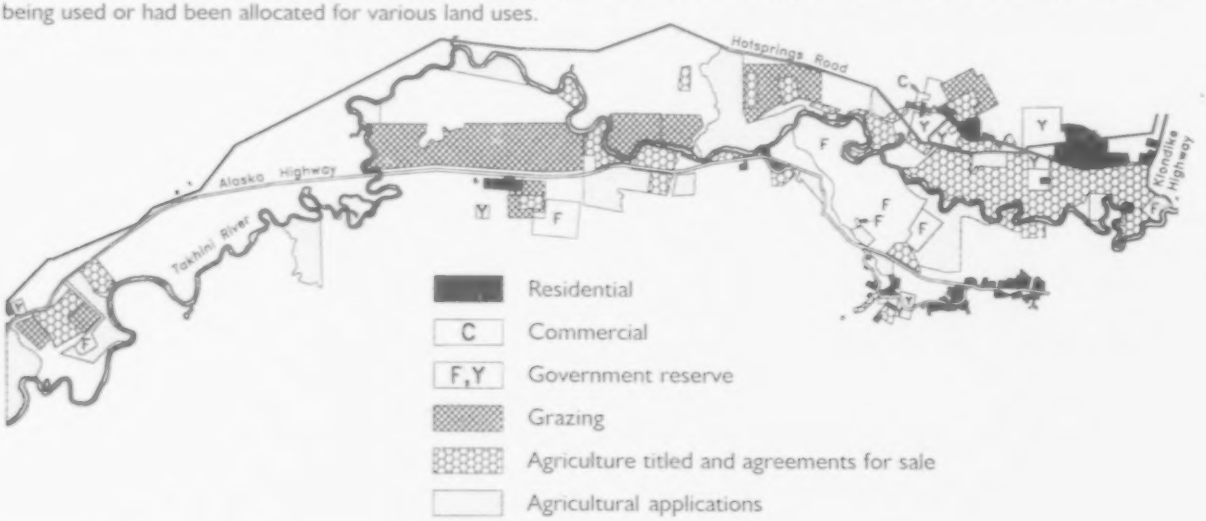
In addition, less than 1% of land is allocated for commercial use.

The conversion of agricultural land to non-farm use has been minimal in the Takhini Valley, likely due to the implementation of the Agriculture Policy which provides for the preservation of farmland. Although highway development has occurred on agricultural land, only a small portion of farmland has been developed for rural residential use.

Urban residents want to preserve open space close to the city for recreation and enjoyment of nature, and rural residents want to maintain the character of their areas. Some development is inevitable. However, it is the

Figure 3.16
Map of Takhini Valley land use, 1994

In 1945, the Alaska Highway and the Takhini Hotsprings were the only developments in the Takhini Valley. In 1975 less than one hectare of rural residential land had been developed; by 1994, as shown below, most of the suitable land was being used or had been allocated for various land uses.



1905 TURN OF THE CENTURY

1905 Extensive mining development takes place on Montana Mountain south of Carcross.

1906 Silver discovered at Galena near Mayo.

Venus Mine. *Yukon Archives/Muirhead Coll.*

intensity and type of development that will determine whether rural environments can be preserved. The provisions of the Agriculture Policy, which restricts subdivision of agricultural land, is a mechanism that, if implemented consistently, will limit the density and maintain the rural environment in areas such as the Takhini Valley. The land use planning provisions of the Yukon land claim agreement also set out a process that can be used to guide future land use in areas where there are competing land use demands and where there are pressures to convert remaining public open space to privately developed land.

Tourism

Yukon scenery and wilderness areas are important in attracting overseas and North American visitors to the territory, with 43 per cent of visitors stating that Yukon scenery was their most positive experience.[1] Global interest in the remaining wilderness areas of the world, combined with a targeted marketing effort, has resulted in an increase of overseas visitors to the Yukon. This trend is expected to continue.

The economic impact of tourism has been difficult to assess due to its role in many sectors of the economy. In many cases, visitors and local residents use the same products and services, making it difficult to distinguish between the two. There is widespread agreement, however, that the tourism industry is a valuable economic income generator, injecting over $50 million in direct out-of-pocket expenditures to the Yukon economy and accounting for a large component of the labour force.

Tourist visitation to the Yukon is expected to increase over the years leading up to the Gold Rush centennials, making tourism an even larger component of the Yukon labour force and economy.

Tourism could affect the Yukon's ecosystems and wilderness areas. Because of the extensive natural wilderness areas in the Yukon, the effects from tourism are only beginning to surface. Backcountry impacts are a concern for resource managers, residents and the tourism industry. Some waterways are already showing signs of increased use. The Yukon River, which is expected to attract greater numbers of travellers in the years leading up to the Centennials, is of particular concern, as are several other rivers that have recently experienced increased use.

Highway travellers also demand services including effluent dumping and waste disposal. There is more interest in developing new services along the Alaska Highway corridor as a result of improved land availability and the possibility of opportunities with the upcoming centennial celebrations. As a result, there is increasing potential for visual impacts along highways.

To protect the resources important for tourism, government and the tourism industry have been cooperating in a number of areas. This includes placing environmental messages in the media, translating the "No Trace Checklist" and developing environmental guidelines for wilderness adventure tourism. Governments are also working co-operatively to implement the provisions of the Environment Act, including the anti-littering and RV dumping sections.

The "Yukon Vacation Guide" and other tourism literature include a number of messages that encourage tourists to act responsibly by:

- respecting and not removing historic artifacts;
- managing their own litter;
- practising no-trace camping and safe and low-impact wildlife viewing; and,
- respecting First Nation culture and way of life.

Trends in Tourism 1987–1994

In 1994, 13,100 more visitors came to the Yukon than in 1987, an increase of seven per cent. The greatest change occurred in overseas visitors, an increase of 152 per cent over 1987. Travel by private vehicle increased by 26 per cent and travel by motor coach declined by 33 per cent. Travel by air increased by 45 per cent and recreational vehicle travel increased by 64 per cent. Expenditures by visitors to the Yukon between June and September 1994 were estimated at $50 million.

Yeah, lots of moose them days. I figure one person catch in one year maybe three, four moose just for summer time. We maybe catch three, sometimes, to dry —and then just one family that. Then winter time maybe two.

— Stella Boss, Champagne Aishihik Elder

Chapter 4 The Living World

Biodiversity and the distribution and status of plants, fish and wildlife are discussed in this chapter, with particular emphasis on species that are rare and on local populations that may be declining. Two important types of Yukon ecosystems, forests and wetlands, are described in Chapter 5.

Biodiversity

In 1992 Canada, along with about 160 other countries, signed a Global Convention on Biodiversity. Media attention has ensured that most people have at least heard the term 'biodiversity', but what does it mean? Biodiversity refers to the number of different biological species found in an area, as well as the genetic variation among members of the same species.

Organisms seldom live in isolation; rather, they are drawn into a web of interrelationships with other species and their physical environment. These associations are called ecosystems. Biodiversity is one way of summarizing the variety of life we see in ecosystems. The list ranges from microscopic organisms to carnivores and from mushrooms to green plants.

Biodiversity may differ from one ecosystem to another. Ecosystems vary across the Yukon because of different climates and geographical features. Change in biodiversity at this geographical scale is called 'landscape diversity'. Large-scale patterns in plant and animal communities help us classify areas that have similar features. This approach was used to develop the boundaries for the reporting units shown in Chapter 6.

Biodiversity is important for various reasons. Yukon forests provide many resources – berries, wildlife habitat, clean water, fuelwood, medicine, building materials. Forests are also home to many different kinds of animals, birds, plants, fish, insects and microorganisms – each linked to the overall functioning of the forest.

What are the consequences of *losing* species and decreasing biodiversity? Yukon placer miners, for example, occasionally uncover

Exotics in the Yukon

The introduction of new species to an ecosystem may have unexpected effects. The introduced species may blend harmoniously with the existing biota or, in extreme cases, may cause the extinction of locally-adapted species and lead to a loss of biodiversity. Several exotic species have been introduced to the Yukon by humans.

- Some Yukon road rights-of-way are seeded with grass to reduce soil erosion and for aesthetic purposes. In the recent Shakwak Highway seeding program, 45 per cent of the seed mix consisted of native Yukon grass species, 30 per cent was a non-native variety of a species of grass that is native to the Yukon and 25 per cent of the seed mix was non-native grass species.
- Rainbow trout do not occur naturally in the Yukon River watershed and are considered an exotic species. They were intentionally introduced to McIntyre Creek and the more aggressive rainbow trout may be competitively displacing local Arctic grayling. Rainbow trout numbers are increasing while grayling are declining in sections of the creek they share.

1906 TURN OF THE CENTURY

Yukon Archives/Ernest Posley Coll.

1906 Whalebone market crashes from $5 a pound down to 40¢. Commercial whaling ends in the western Arctic the following year.

1908 No ships, scarce game, near famine conditions on Herschel. Police feed 47 Inuit on the island from their own stores.

1908-1911 Stefansson-Anderson Expedition conducts survey and exploration of the North Slope of the Yukon.

the remains of extinct animals frozen in permafrost. Species extinction can be a natural process (independent of human influence), but on a global scale, we are rapidly losing biodiversity because of human activity. Few Yukon species are faced with extinction (see Section 4.4) and the biodiversity of our undisturbed ecosystems has a global significance.

4.1 Plants

The vegetation of the Yukon, broadly speaking, consists of boreal forest and tundra. Trees cover the plateaus and valleys in southern Yukon, with the greatest variety of tree types in the southeast of the territory. White and black spruce, lodgepole pine, aspen and balsam poplar are common species. At higher elevations, alpine fir is the main species in the south central and eastern Yukon, while white spruce occurs in subalpine forests in western and northern areas. Shrubs, especially willow and shrub birch, are increasingly prevalent the further north one travels.

Tussock fields of sedges or cottongrass, mixed with forbs, lichens and mosses, are the main vegetation on the Arctic tundra. Alpine tundra supports several vegetation communities, including numerous dwarf shrubs, lichens, mosses, forbs, sedges and willows. Grasslands are very restricted in area and occur on south-facing slopes along drainages in the south and central Yukon.

The distribution of plants is affected by climate and terrain. Evidence of increasingly warm summers in the Yukon was presented in Section 1.1. A warmer climate will alter the distribution of permafrost and increase the amount of heat available for plant growth. Long-term monitoring of vegetation plots has been established in Ivvavik National Park to track the effects of climate change on vegetation.[1] Remote sensing by satellite is also being used to map the distribution of vegetation to monitor changes across Canada.[2]

The main commercial use of plants is timber harvesting (see Section 5.2 and 6.5). Yukoners also harvest a variety of plants to eat, to use as medicines, for arts and crafts, and to sell.

Rare Plants

A National Museum project in 1981 listed 313 plants as rare in the Yukon.[3] Some of these plants are widely distributed but are not common anywhere; others are restricted to a small area or certain types of terrain. Since this list was prepared, new plants have been found in the Yukon, and some plants thought to be rare have been found to have wider distributions. The first catalogue of the flora of the Yukon, due to be released in 1996 by Agriculture Canada, will incorporate these changes.[4]

Some of the plants that occur here (and nowhere else) have an interesting history. During the last glaciation, many plant species in Canada were eliminated from northern latitudes. Much of central and northern Yukon escaped glaciation, along with adjacent land in Alaska.[5] As well, in the glaciated southern Yukon, peaks protruded above the icefields (nunatuks). These 'refugia' provided islands of habitat where some plants could persist. There are over 30 known distinct types of plants that survived in these island refugia and now occur only in the Yukon or in the Yukon and neighbouring parts of Alaska. The ranges of some also extend just over the BC or NWT borders.

Examples of rare Yukon plants:

- A type of sedge (*Carex sabulosa* ssp. *leiophylla*) must have survived the ice age on nunatuks in the glaciated southern Yukon. First described at the Carcross

Even the roots we eat. Roots, we never starve. Even winter time you put fire on it, thaw them out. Bear roots you eat. The spring time come, if you hungry, well, you peel trees, you eat sap. Use it for medicine, too.

Charlie Dick, Ross River Dena Elder

1909

Twelve Mile Ditch Opens

A major water diversion project 70.2 miles long brought water to the hydraulic operations on Bonanza Creek.

Yukon Archives/Schellinger Coll.

Desert sand dunes in 1914, it has since been found on sand dunes at three other southern Yukon locations.

- The purple 'many-headed anemone' (*Anemone multiceps*) survived the ice age in the unglaciated Yukon/Alaska refugium. It now grows on Arctic and alpine tundra in parts of northern Yukon and northern Alaska.

Plants and Health Care

Modern medicines are frequently derived from natural plant extracts and there is heightened awareness of the potential medicinal value of plants that we have not yet examined. Traditional knowledge passed on by elders has pointed out the healing powers of many plants (Figure 4.1). Studies show that some plants, such as horsetail and anemone, have antibiotic properties and that other plants, such as spruce needles, contain high amounts of vitamins.[6]

As part of the First Nations health program, the new Whitehorse Hospital will include a traditional healing room. This facility will help pass on elders' knowledge about traditional medicine. A working group of elders and healers from several Yukon First Nations is guiding the design of the new facility. Plans include a preparation room where plants can be dried and stored and medicines prepared. Traditional medicines will be used to help prevent illness as well as to treat ailments.[7]

Contaminants in Plants

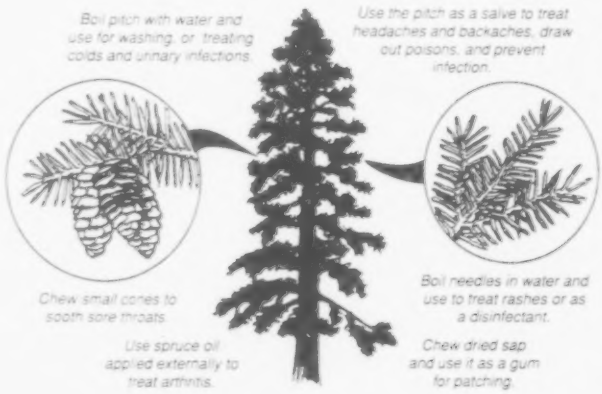
First Nations people have expressed concerns about potential contamination of traditional food sources. Elders report that they no longer use traditional berry patches located within walking distance of villages because of substances in the road dust.[8]

Pollutants may enter the food chain two ways: from point sources (such as mine tailings or highways) or from widespread, diffuse sources (see Section 1.3). Point-source pollution was the cause of contamination of berries in the Carcross area. In 1985 a study showed that berries had elevated levels of arsenic. The source of the arsenic was primarily windblown dust from the nearby Venus mine site and most of the arsenic-laden dust could be easily washed off.[9]

Another study, completed in 1989 near Whitehorse, found that berries growing in soil contaminated by lead and zinc concentrate did not have elevated levels of metals.[10]

Many metals found naturally in soils are taken up by plants. Metals in plants are usually beneficial to those eating the plants and are only considered contaminants if they appear at high levels as a result of human activity. Analyses of a variety of plants, including berries, roots, bark and leaves, showed no levels of metals above the ranges that would be expected from natural sources. These analyses were part of a study of the safety of First Nation traditional foods and medicines (see also Section 4.3).[11]

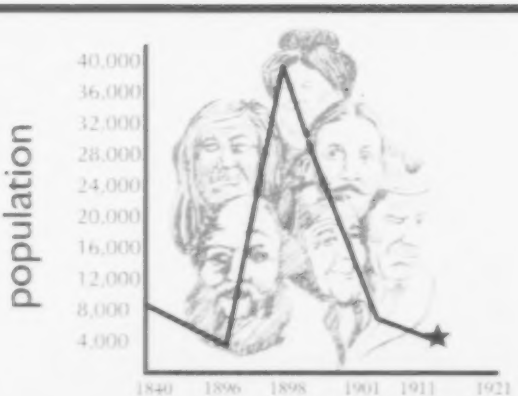
Figure 4.1
The spruce


Boil pitch with water and use for washing, or treating colds and urinary infections.
Use the pitch as a salve to treat headaches and backaches, draw out poisons, and prevent infection.
Chew small cones to sooth sore throats.
Boil needles in water and use to treat rashes or as a disinfectant.
Use spruce oil applied externally to treat arthritis.
Chew dried sap and use it as a gum for patching.

1912 THE GREAT WAR

During the Gold Rush they used to come up to the White River with barges, you know, and then in the winter they would have horse sleighs and they would just hunt. You know they had 30,000 people to feed in Dawson City. So they hunted the whole Yukon to send that meat down there. I got books from 1912, my Dad's hunting parties, the guys kept diaries. And there's more game now than there was then.

— Dick Dickson, Kluane Elder



4.2 Fish and Fish Habitat

The Yukon's lake and river systems support populations of freshwater fish, including lake trout, whitefish, northern pike, burbot, cisco, arctic grayling and suckers. Yukon waters also provide rearing habitat, migration corridors and spawning grounds for four species of Pacific salmon. On the Yukon North Slope, charr move between rivers and the Beaufort Sea.

Fish in the Yukon are caught mainly in First Nation fisheries and in commercial and sport fisheries (Figure 4.2). The commercial fishery for salmon is centred at Dawson City. Small commercial freshwater fisheries operate on some Yukon lakes, and guided sport fishing is provided by outfitters. Salmon originating in the Yukon are also caught in fisheries in Alaska and in the Pacific Ocean and Bering Sea.

The Business of Fishing

Approximately 22 businesses offer fishing expeditions in the Yukon, ranging from a three-hour excursion near Whitehorse to week-long stays at remote, fly-in fishing camps and lodges. Stores selling fishing supplies and a range of other businesses benefit from fishing activities.

Salmon

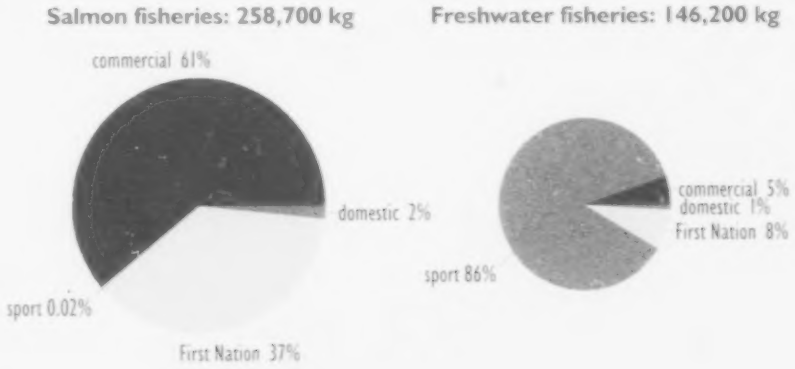
Pacific salmon spend the early part of their life cycle in fresh water, migrate to the ocean to complete their growth and to mature, and then return to fresh water to spawn and die. Most of the salmon's growth is in the ocean where they feed on plankton, crustaceans and smaller fish. Salmon travel thousands of kilometres at sea before returning to spawn in the same freshwater body where they were hatched.

The length of time salmon spend in fresh water varies from species to species and even between different populations of the same species. Chum salmon in the upper Yukon, for example, spawn in the fall. The eggs hatch in the winter and early spring and the fry begin their migration to the Bering Sea almost immediately after spring break-up. Young chinook salmon in the upper Yukon, on the other hand, do not start their seaward migration until they have spent one or even two years in fresh water. Most lake-spawning sockeye in the Yukon also spend a year rearing in fresh water before migrating to the ocean. However, many sockeye populations that spawn in side channels in major rivers migrate to the sea in their first year. At the other extreme are kokanee, a form of sockeye that spend their entire lives in fresh water.

The deep, rich red colour of sockeye salmon flesh is a result of a diet of mainly shrimp. The shrimp are rich in a red pigment which is taken up by the flesh of the salmon.

Figure 4.2
Estimated Yukon fish harvest, 1989

Chinook made up 59% of the salmon commercial harvest and 75% of the First Nation salmon fishery. Seventy-four per cent of the freshwater sport fishery was for lake trout and 9% was for Arctic grayling.



1911 North Klondike River Dam constructed. Salmon stock declines.

1912 First car in the Yukon travels the Overland Trail from Whitehorse to Dawson.

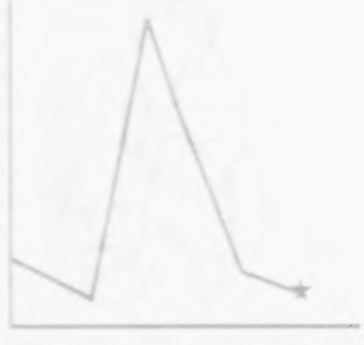
1913 Peak year of operations for the gold dredges in the Klondike Goldfields. Dredge tailings still dominate the landscape in many Klondike valleys.

Yukon Archives/Schellinger Coll

Contaminants in Plants

Plants and Health Care

Figure 4.1
The spruce



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Salmon fisheries: 258,700 kg

Freshwater fisheries: 146,200 kg

The Business of Fishing

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Figure 4.3
Chinook spawning areas in the Yukon River Basin

Yukon River chinook salmon swim upstream from the mouth of the river at the Bering Sea to the headwaters, a distance of up to 3,200 kilometres. The spawning areas are critical to sustaining populations.

In the Yukon River, chinook salmon swim as far upstream as Whitehorse and beyond, having begun this remarkable freshwater journey in the Bering Sea (Figure 4.3). Yukon River chum salmon that spawn in the upper Yukon and tributaries, such as the Teslin River, undergo some of the most extensive freshwater migrations of this species in the world. In the Porcupine sub-basin, which extends north of the Arctic Circle, chinook, chum and coho salmon migrate upstream past the village of Old Crow to spawn in the Fishing Branch River. In the Alsek drainage, chinook, sockeye and coho salmon spawn in a number of headwater tributaries of the Tatshenshini River. Some of these spawning locations are above treeline.

The chinook, or king salmon, of the Yukon River are known as the 'king of kings'. Once in fresh water, salmon do not feed but depend on their bodies' oil reserves for energy to make the long voyage. Because their journey is long, Yukon River chinook have twice the oil content of most other salmon. This high oil content makes them the tastiest salmon in the world and the most expensive when captured at the beginning of their journey at the Bering Sea or the mouth of the Yukon River. There is a large demand for Yukon River chinook.

Silver at Keno Hill!

June - The first shipment of silver ore from the Silver King mine began its journey from the Mayo dock to a smelter in San Francisco. From 1914 until 1986, with few interruptions, lead-silver was mined in the Keno Hill area.

Ore sacks in Mayo awaiting shipment to Whitehorse.
Yukon Archives/Hare Coll.

Salmon have a long tradition of use by Yukon First Nations. The importance of and reliance on the salmon is reflected in lifestyles and ceremonies. The 'first fish' ceremony, for example, is celebrated by the people of the southwest Yukon with the arrival of the yearly salmon run.

First Nations have used certain stocks of salmon for many hundreds of years. Increased exploitation of the fish in the twentieth century, however, has dramatically affected some stocks. Commercial fisheries for salmon in Yukon drainages started in the early 1900s. Commercial fisheries have been established on both the Alsek and Yukon River stocks in Alaska but only on the Yukon River stocks in Canada. Sport fishing and subsistence fishing, such as the aboriginal food fishery, are conducted on both river systems.

Salmon: an International Resource

The Yukon and Alsek Rivers flow through both Canada and the United States. Yukon salmon are harvested not only by Yukoners but, to a much greater extent, by Alaskans (Figure 4.4). These salmon are also captured in the open ocean by foreign fishing fleets. With so many interests wanting a 'piece of the action', management of the salmon is a complex and difficult task. Unfortunately, the countries involved have not been able to agree on how the salmon resources should be managed and shared.

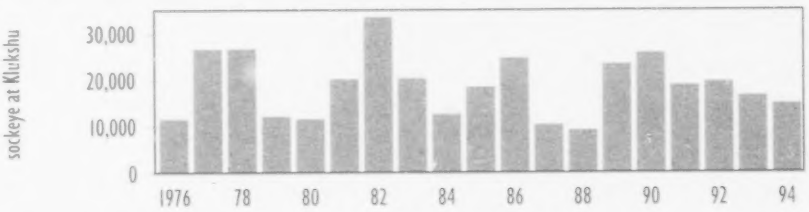
Long time ago, oh you see lots of salmon. That's what the people live on. Make dry salmon in the spring time. Spring, when the salmon come up in July, they make salmon trap across the river where a shallow, shallow place. I don't know how many families work together to make dry fish for winter time – maybe four, five camps. They build a big cache and they put in cache for winter. That's how we dry salmon.

Charlie Dick, Ross River Dena Elder

Figure 4.4
Alsek River sockeye salmon

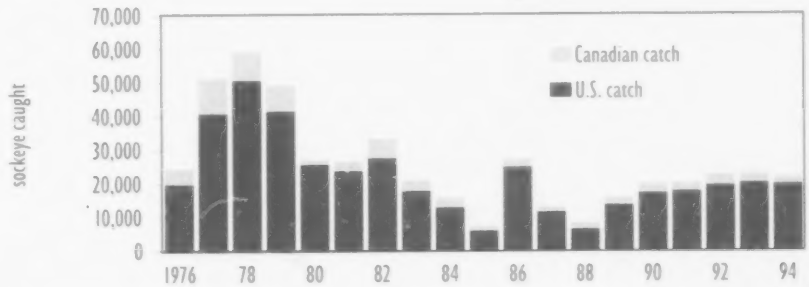
Klukshu weir sockeye counts

Fisheries and Oceans Canada estimates that 70% of all Alsek sockeye salmon are hatched in Canadian waters. Sockeye counted at the Klukshu weir represent an estimated 33-66% of the total Alsek River system sockeye run.



Fishery

In the U.S., sockeye are caught mainly in the commercial fishery. In Canada, sockeye are caught in an aboriginal food fishery and sport fishery in the Tatshenshini River and its tributaries. On average, 87% of the total catch is by the United States.



Easy on Fuel it ain't

At one time there were 200 sternwheelers running the Yukon River. A sternwheeler typically used 1½ cords of wood an hour coming upstream. The trip from Dawson to Whitehorse consumed 144 cords of wood.

Yukon Archives/Pepper Coll.

The Pacific Salmon Treaty was signed by Canada and the United States in 1985. The treaty has not resolved problems and the welfare of many Pacific salmon stocks may be in jeopardy. An outstanding issue in salmon treaty negotiations is the allocation of the resource.

Many salmon spawn and spend the early parts of their lives in Canadian waters, but the salmon swim through U.S. waters when returning to spawn and a large number of fish are harvested in U.S. fisheries. The Pacific Salmon Treaty was intended to establish salmon conservation requirements and to create a fair distribution of the benefits from this international resource. Talks failed in 1994 with no resolution on joint fishing plans. As a result both Canada and the United States developed unilateral fishing plans which, when combined, may not meet the conservation requirements of Pacific salmon stocks.

An exception to this lack of progress in international cooperation is a recent outcome of negotiations on Yukon River salmon management. In December 1994, Canada and the United States signed a three-year interim agreement on Yukon River salmon stocks. This agreement is an important milestone in negotiating a separate Yukon Salmon Treaty. The agreement includes:

- a joint rebuilding plan for depressed Canadian chum salmon stocks;
- a stabilization plan for chinook salmon; and,
- a Yukon River Salmon Restoration and Enhancement Fund. This fund will be used to conserve, restore and perhaps enhance the upper Yukon River salmon stocks in Canada.

Assessing and Managing Yukon Salmon Stocks

Management of salmon in the Yukon is the responsibility of Fisheries and Oceans Canada. Their management strategy states that stock conservation comes first, then protection of stocks for the aboriginal fishery followed by commercial and sport fisheries. However, as the Alaskans have 'first crack' at harvesting the salmon, the health of Yukon salmon stocks ultimately depends on international cooperation. Management plans are designed to reflect arrangements made through the Pacific Salmon Treaty and the Yukon Salmon Treaty negotiations.

Sport Fishing at Sha'wa She

The popular sport fishery at Shaw'a She (Dalton Post) on the Alsek River system is one of the few inland sport fisheries for sockeye salmon in Canada. Facilities at this location are inadequate to accommodate all the sport fishers during the sockeye salmon run. Catch restrictions limit daily possession and sport fishers are allowed to catch as many salmon as they wish as long as they release all salmon caught in excess of the possession limit. This conflicts with First Nations' philosophies as it is considered disrespectful to the fish. The practice of catch and release of salmon injures a small proportion of the salmon – one study showed that, with proper catch and and release techniques, fewer than 10 per cent of the fish released die. However, a fish that has been caught and released may also have less chance of spawning successfully, due to trauma from the hook or stress from the fight.

Kokanee in Kathleen and Frederick Lakes

Kokanee are a landlocked form of sockeye salmon that spend their entire lives in fresh water. In the Yukon, kokanee are found in Kathleen and Frederick lakes, part of the upper Alsek River drainage. About 140 years ago, the forces of nature, through the surging Lowell glacier at Naludi (Southern Tutchone for 'fish stop place') in Kluane Park, prevented sockeye salmon adults from migrating upstream from the ocean. This resulted in the blockage of anadromous stocks and their eventual disappearance from the upper Alsek drainage.

1915 THE GREAT WAR

Whales Out, Fur In

On the Arctic coast, the whaling industry is replaced by fur trade in white and silver fox fur.

Taking on bales of white fox pelts at Herschel Island. *Yukon Archives/Finnie Coll.*

Objectives for conserving Yukon salmon stocks are set by joint technical committees working under these international agreements. Objectives are set for levels of escapement – the numbers of salmon that 'escape' the various fisheries each year to reach spawning grounds. Fisheries and Oceans Canada monitors salmon escapement in the Yukon through tagging programs, counting weirs and aerial surveys of spawning grounds. Increasingly, these programs are being carried out with local First Nations.

The total annual Canadian and American catch of Yukon River chinook, the annual escapement to the spawning grounds in the Canadian portion of the river, and the management escapement objective are shown in Figure 4.5. Table 4a is Fisheries and Oceans Canada's assessment of the status and trends of Yukon chinook and other major Yukon and Alsek River stocks.

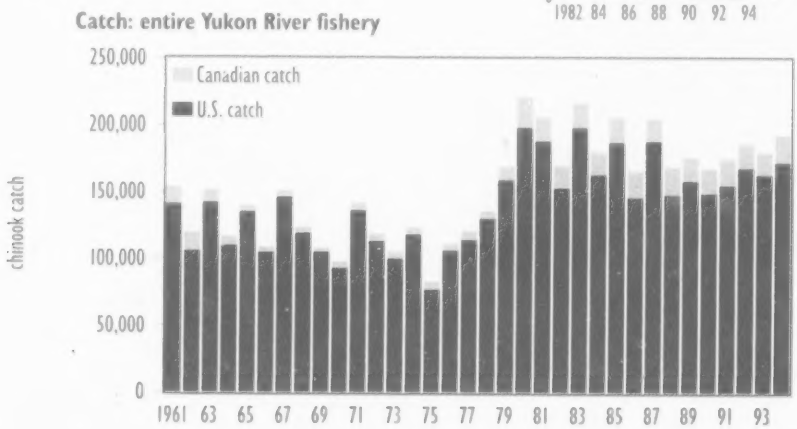
Table 4a
Status and trends of Yukon salmon

River System	Species	Status of Stocks	Trend
Alsek	chinook	moderate level	increasing
Alsek	sockeye	moderate level	stable
Alsek	coho	low level	stable
Yukon mainstem	chinook	low level	stable
Yukon mainstem	chum	have declined	remain low; significant increase in 1994 and 1995
Porcupine	chum	have declined	remain low

Figure 4.5
Yukon River chinook salmon

'Chinook escapement' refers to the number of salmon returning to the spawning grounds. The escapement objective is set by an international technical committee.

Canadian and U.S. chinook catches in the Yukon River include the commercial, subsistence, domestic and sport fisheries. On average, 51% of the U.S. catch of Yukon River chinook is of Canadian origin.



Subsistence fishing for salmon in Canada is allowed for a few non-aboriginal people engaged in a rural lifestyle. This is classified as a 'domestic' fishery. In Alaska there is no distinction between aboriginal and non-aboriginal fishing. All rural residents of Alaska are allowed to subsistence fish.

Fox Farms

The government recorded 17 fox farms located close to abundant supplies of whitefish and salmon. One group of farms was at Carmacks, or Tantalus as it was called, where both salmon and caribou were available.

Yukon Archives/Webb Coll.

Freshwater Fish

There are approximately 40 species of fish in the Yukon, 10 of which are strongly favoured by sport anglers and other users of the resource. The popular freshwater fish include Arctic grayling, lake trout, northern pike, whitefish, rainbow trout, and, more recently, burbot or 'ling cod'. The First Nation subsistence fishery targets primarily whitefish, lake trout and ling cod.

Fish have been an important resource for Yukon First Nations for thousands of years. During the fur-trading and gold rush periods, fish were used for subsistence and to some extent, commercially. During the Klondike Gold Rush, demands increased for fish as dog food and for a rapidly increasing human population. The Klondike River was heavily fished for Arctic grayling between 1898 and 1910. Between 1905 and 1913, a total of 47 commercial and 47 domestic fishing licenses were issued by the newly appointed Inspector of Fisheries at Dawson. Around 1913, the fur farming industry was established and large amounts of fish were used for animal food for the next several decades. The effects of these heavy rates of exploitation have not been documented, but managers suspect that some stocks were severely depleted and have not recovered.

Well, all different fish we eat. We eat suckers sometime. Jackfish in spring time when come out of ice. Whitefish always good year round – but jackfish summertime not very good eating, they say. Soft meat and kind of spongy-like. Jack fish good eating winter time because under the ice. Grayling, spring time good. Towards summer, when water get hot, well it turns soft, too. Suckers always same all the time. Trout always good. Trout follow cold water all the time. When water get warm, they move to where cold stream coming off the mountain or wherever cold water coming, running into lake.

Moose Jackson, Champagne Aishihik First Nation Elder

Currently, Yukon freshwater fish are harvested through sport fishing, and in commercial, domestic, and aboriginal food fisheries. The number of sport anglers has increased since the early 1950s, as shown by the increase in sales of licences (Figure 4.6). The number of sport anglers has levelled off in the past 15 years. Fishing patterns have changed during that time period, however, with more sophisticated equipment and better access to large lakes increasing the annual catch for many sport anglers.

Bountiful harvest

Around the turn of the century, Fort Selkirk and Dawson City were supplied with fish from Tatlmain Lake, situated east of present-day Pelly Crossing. As many as 10,000 fish (mainly whitefish) were taken from this lake in some years.

Cold Waters – Slow Growth

Many Yukon freshwater fish spend their entire lives in frigid, relatively unproductive lakes. While these cold, clear waters are part of the appeal of the Yukon fishery to the angler, they produce fish that are very slow to grow and reproduce. A comparison of lake trout from Bennett Lake, Yukon and lake trout in Ontario indicates a notably slower growth rate for the Yukon lake trout. (Figure 4.7). This makes northern fish more vulnerable to overharvest.

Assessing and Managing Yukon Freshwater Fish Stocks

In 1989, responsibility for management of freshwater fish was transferred from the federal Department of Fisheries and Oceans to the Yukon government. The government's primary management objective for freshwater fish is to ensure the sustainable use and development of the fish resources for present and future generations. To achieve this, the Department of Renewable Resources has implemented fish stock assessment and management policies and programs.

THE GREAT WAR

The Copper Chief

Beginning about the eighth century, the people around Aishihik became famous for their copper knives and spearheads. The Copper Chief, with his headquarters near Snag, controlled the trade in these items until the late nineteenth century when trade items from the fur traders supplanted copper in importance.

Long ago an Indian had both an iron pick and a copper pick. Using the picks, he climbed up the steep ice wall high on a mountain known as Nat'ayat (Mt. Natazhat), but when he got there, he could not climb back down. The steps he had chipped out with his picks had melted into smooth ice. So the man just sat there until he finally turned to rock. Before he died he threw his iron pick down towards the salt water. It is said that is why the Indians there had iron. But he threw his copper pick towards the Interior, saying, "Be copper on this side!" That is why the Yukon Indians have copper.

— Albert Isaac, Champagne Aishihik Elder

Figure 4.6
Sport-fishing licence sales

Licence sale totals include resident and non-resident licences. Over the past decade, between six and seven thousand season licences were issued to Yukon residents each year.

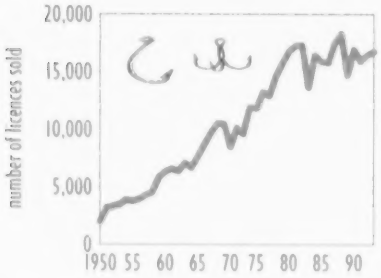
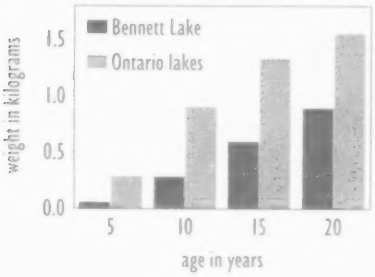


Figure 4.7
Growth rates of lake trout: Yukon versus Ontario lakes

Lake trout grow more slowly in the cold waters of large Yukon lakes than in Ontario lakes of comparable size. Data are average weights of trout of different ages, derived from lake trout data from Bennett Lake and several Ontario lakes.



Little information is available about the numbers of freshwater fish in most areas of the Yukon. Data are usually from one-time surveys and do not provide information on changes in fish populations. Surveys and assessments that would provide trend data are costly and time-consuming. The emphasis in fish stock assessment is on collecting a single set of baseline information from numerous large, multi-use lakes, as opposed to gathering repeated data over a number of years from the same lake.

Standard gillnet surveys are conducted by Yukon fisheries scientists to gather information about fish stocks in lakes. Nets of standard mesh sizes and lengths are set for specific periods of time. Fish captured during surveys are counted, weighed and measured, their stomach contents are analysed and their sex and age are determined. This information is used to make inferences about the status of fish populations. The number of fish captured through netting over a certain period of time is used to calculate a catch per unit effort.

The relative amounts of the various species of fish caught in the gillnet surveys is used to evaluate fish stocks in lakes of similar size, productivity and fishing pressure. From surveys conducted since 1989 and from earlier studies on Yukon lakes, fisheries scientists have concluded that lake trout populations are relatively stable in lakes in which this species make up at least 30 per cent of the weight of the total fish catch.[1] The proportion of lake trout to total catch is used as a management tool to assist in the development of commercial and sport fishery quotas and regulations, with 30 per cent lake trout being considered a target for most Yukon lakes. Ratios of lake trout to total catch from surveys of nine Yukon lakes are shown in Figure 4.8.

Key policies and programs in place for freshwater fish management are:

- **Special Regulations for High Quality Waters** – designed to increase the chances for a high quality fishing experience. In lakes designated as High Quality

Exotic Fish, Parasites and Diseases

Introduction of fish species which are not native to a certain area is restricted by the Fisheries Act of Canada. A pond receiving the overflow from a hot springs recreational area near Whitehorse was home to many goldfish that had been put into the pond over a period of years. Because this pond drains into the Takhini River, fisheries scientists were concerned that exotic diseases or parasites might be introduced from the pond water into the Yukon River system. In 1994, an estimated 50,000 goldfish were destroyed and removed from this pond of less than one hectare.

Copper at Peak

Copper ore exports peaked at 2.8 million pounds. Large-scale copper mining began about the time of the Klondike gold rush. Copper mine operations ended about 1920 with a drastic drop in the world market price. In the 1960s, copper again became an important part of the Yukon's economy.

Pueblo copper mine, 1913.
Yukon Archives/MacBride Museum Coll.

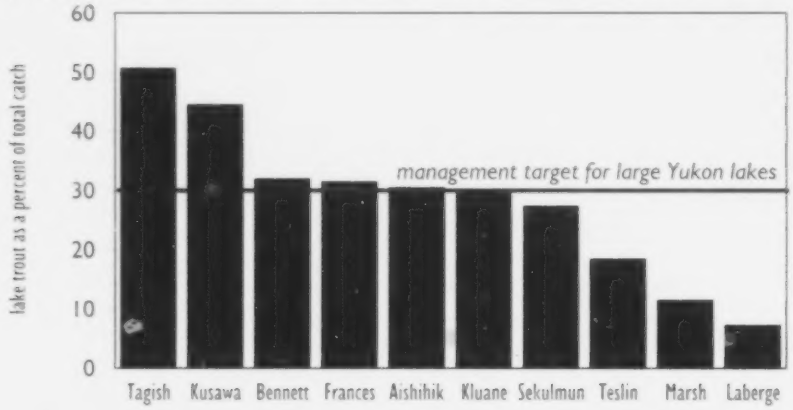
Waters, anglers can only keep fish within a specified size range. This is to conserve those fish which are the most productive breeders. Fish that are released must be returned to the lake unharmed. The use of barbless hooks is required and education programs teach anglers to minimize damage to caught fish. Catch limits may also be reduced to protect fish stocks.

- **Decrease in the Commercial Harvest** – Lakes open to commercial harvest have been reduced from 20 in 1990 to four in 1995
- **Stocking of Pothole Lakes** – Rainbow trout, kokanee and Arctic charr have been stocked in pothole lakes to offset sport fishing pressure on native Yukon fish stocks.

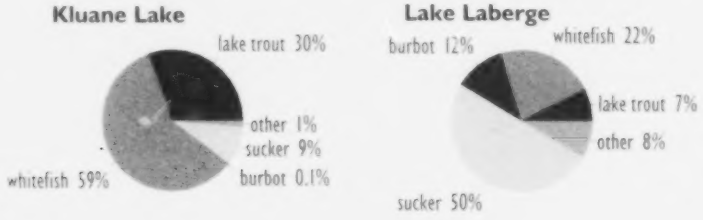
Figure 4.8

Species composition of fish catches in surveys of large Yukon lakes

Large lakes with cold, deep waters provide the best conditions for lake trout. In these lakes, if lake trout have not been depleted through overharvesting, they make up at least 30% of the catch (by weight) in standardized surveys. The species composition will vary naturally from lake to lake, depending on habitat conditions. For example, lakes with extensive shallow zones support larger populations of pike. Data are from gillnet surveys conducted from 1990-1993.



Full species composition of catch for two contrasting lakes



Case Studies in Yukon Freshwater Fish Management

Lake Laberge

A suspected decrease in lake trout populations in Lake Laberge was confirmed through gillnet surveys in 1991. Low numbers of lake trout and high numbers of longnose suckers and burbot were captured (Figure 4.8).

Lake Laberge lake trout are known for their excellent quality. *But I'm not kidding you when I say that I eat the best trout down at Lake Laberge. It used to be nice, firm meat. Cold, deep water, maybe 900 feet deep in some places, that lake.* (Henry Broeren, Ta'an Kwach'an First Nation Elder)

When compared with the stable fish populations in Kluane Lake, the relatively large numbers of suckers and burbot in Lake Laberge are very noticeable (Figure 4.8). *There was lots of whitefish, lots of trout. There was some suckers, but now they make it just full of suckers and pike.* (Henry Broeren)

In an attempt to rebuild the lake trout stocks, Lake Laberge has

THE INTERIM YEARS

What you need that's all you get. When you really need it. Not supposed to kill animal for nothing. Not for fun. Because he saved too many people's life. Even the porcupine, when you starve, you get porcupine, you cook it. That's good. Save your life.

— Charlie Dick, Ross River Elder

been closed to commercial fishing, the domestic fishery has been restricted and the aboriginal fishery has been voluntarily-reduced. Fish stocks in Lake Laberge are being monitored to determine if the lake trout populations are responding to this reduced fishing pressure. These changes in the harvest of lake trout were also related to the discovery in 1991 of relatively high levels of toxaphene in Laberge lake trout (see Contaminants in Fish, below).

Little Atlin Lake

Little Atlin Lake is a popular fishing spot located 80 km south of Whitehorse on a good, all-weather road. The lake has an extensive shallow zone which is suitable for the production of plants, invertebrates and juvenile fish, and a deep centre sector which provides good habitat for relatively large lake trout. The lake water is relatively high in nutrients.[2] Northern pike and whitefish are abundant in the lake. Little Atlin is usually one of the first lakes to thaw in the spring. It is large enough to produce good-sized lake trout, but small enough to be inviting to modest-sized boats.

Fishing pressure from sport angling and domestic netting has been heavy over the years. Summer and winter fish sampling surveys in 1982–83 produced only six lake trout in Little Atlin, compared to a catch of 27 in a Yukon lake of similar size and depth. The catch in Little Atlin was the lowest of all 18 lakes sampled that year. A survey of Little Atlin in the fall of 1992 produced only two lake trout.

The management strategy for this lake is to divert fishing pressure from lake trout to more abundant, but less popular species, such as pike, through education and regulation of the lake's sport fishery.

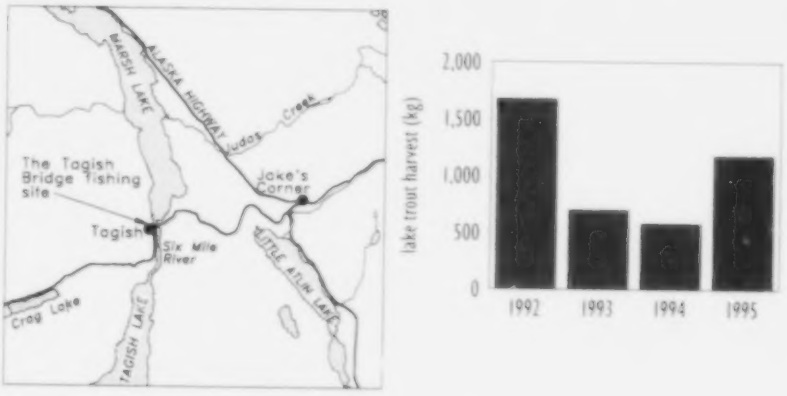
Six Mile River – The Marsh/Tagish Connection

Concerns expressed by Yukon residents, including First Nation members, directed attention to sport fishing activities at the Tagish Bridge. Fish regularly migrate back and forth between the cold, deep waters of Tagish Lake and the shallow, productive waters of Marsh Lake. During this migration, they swim through the Six Mile River and are easily intercepted at the Tagish Bridge.

Gillnet surveys and tagging supported local opinion that harvests of lake trout from the Tagish Bridge played a major role in reducing numbers of lake trout in Marsh Lake. Restricted catch and new size limits applied in 1993 decreased the catch at this vulnerable site by 60 per cent in 1993 and 1994. The harvest increased again in 1995, however, due to increased fishing effort (Figure 4.9). Time will show if these measures are successful in conserving the lake trout population in Marsh Lake.

Figure 4.9
Tagish Bridge angling harvest

New regulations in 1993 resulted in a decrease in the number of lake trout angled from the Tagish Bridge. The objective of this reduction is to conserve the Marsh Lake lake trout population.



Flu a Killer

The world-wide influenza epidemic began in 1918. Yukon First Nations people were particularly hard hit.

Somebody had the flu and everyone got it. We lost the baby first before anyone got sick. Lots of people died in that flu. My father died.
— Angela Sidney, Tagish Elder

Yukon Archives/Anglican Church Coll.

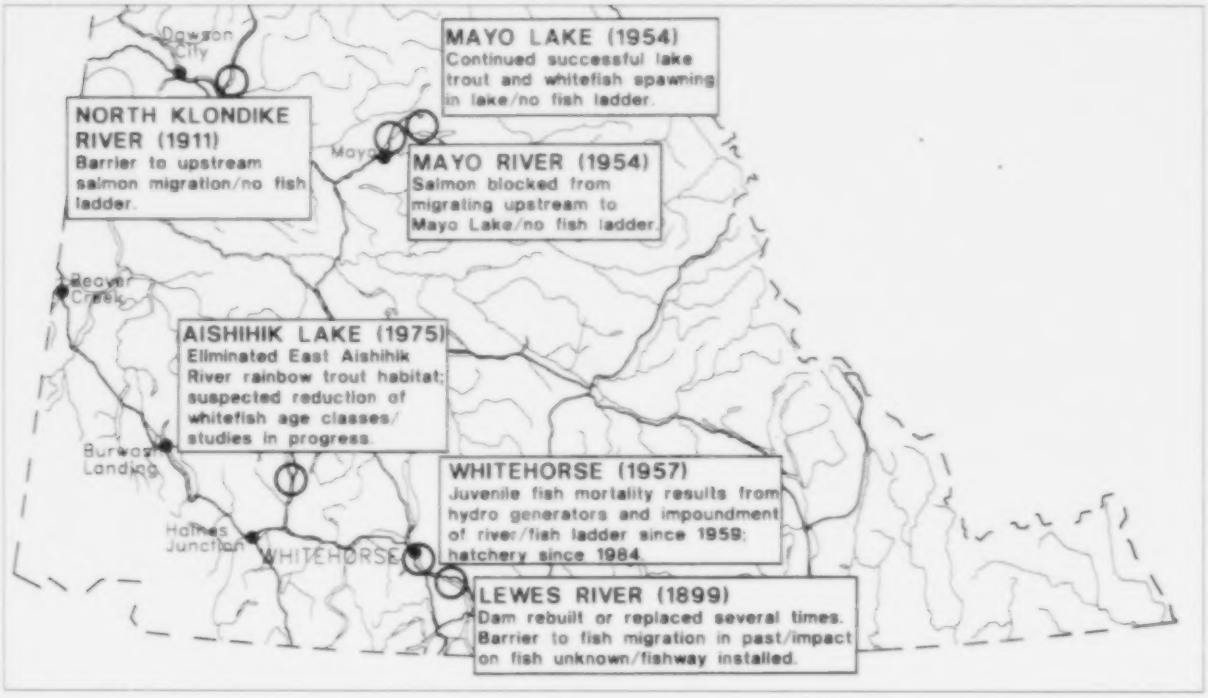
Stocking Up for the Future – Angling to Aquaculture

Stocking of small Yukon lakes for sport angling started in 1946. Lakes were stocked by local fish and game clubs and later by government. During the 1950s and 60s, native 'coarse' fish such as pike were eradicated from some lakes using poisons. The lakes were then stocked with rainbow trout, coho salmon or cutthroat trout. A hatchery at McLean Lake, near Whitehorse, produced fry for lake-stocking. Since 1972, the stocking program has been restricted to small pothole lakes (with no streams flowing in or out) to prevent the spread of introduced fish species, parasites and diseases. Some lakes are now being stocked with rainbow trout or Arctic charr for commercial harvest and sale to local markets. A large-scale Arctic charr hatchery and grow-out facility established in Whitehorse in 1987 produces charr for export and for lake stocking.

Fish Habitat

Equally as important as actual fish numbers is habitat – anywhere fish live and grow during any part of their lives. This includes almost any lake or stream in the territory. The Yukon has an abundance of streams and rivers with few natural or human-made barriers. Fish make use of many streams right to their mountain headwaters. When the glaciers melted, broad valleys and depressions were left in the

Figure 4.10
Major Yukon dams, effects on fish habitat and mitigation measures


Dawson City
NORTH KLONDIKE RIVER (1911)
Barrier to upstream salmon migration/no fish ladder.
MAYO LAKE (1954)
Continued successful lake trout and whitefish spawning in lake/no fish ladder.
Mayo
MAYO RIVER (1954)
Salmon blocked from migrating upstream to Mayo Lake/no fish ladder.
Beaver Creek
AISHIHIK LAKE (1975)
Eliminated East Aishihik River rainbow trout habitat; suspected reduction of whitefish age classes/ studies in progress.
Burwash Landing
Haines Junction
WHITEHORSE
WHITEHORSE (1957)
Juvenile fish mortality results from hydro generators and impoundment of river/fish ladder since 1959; hatchery since 1984.
LEWES RIVER (1899)
Dam rebuilt or replaced several times. Barrier to fish migration in past/impact on fish unknown/fishway installed.

My grandpa used to don't allow us to pick them [duck eggs]. *He used to always tell us, once is enough. Not all the time. You have to have something for next year.*
— Gladys Johnston, Teslin Elder

landscape. Large, deep, cold lakes in mountain valleys and smaller, shallower and more productive lakes and wetlands on plateaus and in broad valleys provide a diversity of fish habitat. In the unglaciated areas of the Yukon, valleys are narrow and lakes are rare. There are few waterfalls or other natural obstructions to the upstream migration of fish. Streams tend to be used on a seasonal basis, with overwintering in larger rivers or in groundwater discharge areas.

Fish habitat consists of both the physical components of the lake or stream and the characteristics of the water. Each species of fish at each life stage has certain requirements, such as clear water, good spawning gravel or overhanging banks for shelter. Degradation of these key habitat features at any life stage can decrease fish survival, growth rate and reproductive capacity.

The major Yukon dams and their effects on fish habitat are summarized in Figure 4.10. The North Klondike and the Mayo dams blocked upstream fish migration. The salmon spawning habitat in the region of both dams has also been damaged by placer mining.

A fishway at the Whitehorse Rapids Dam allows fish to migrate upstream into Schwatka Lake. The Whitehorse Rapids Fish Hatchery was constructed in 1983–84 as a hatchery for chinook salmon, as some juvenile fish are lost while migrating downstream through the dam turbines. Some of the fry released from the hatchery have a small coded wire tag implanted and their adipose fins clipped (the small fatty fin located on the back of the salmon, closest to the tail). The clipped fin identifies these fish as hatchery fish when they return to the fishway so that the survival rate of the hatchery fish can be estimated (Figure 4.11).

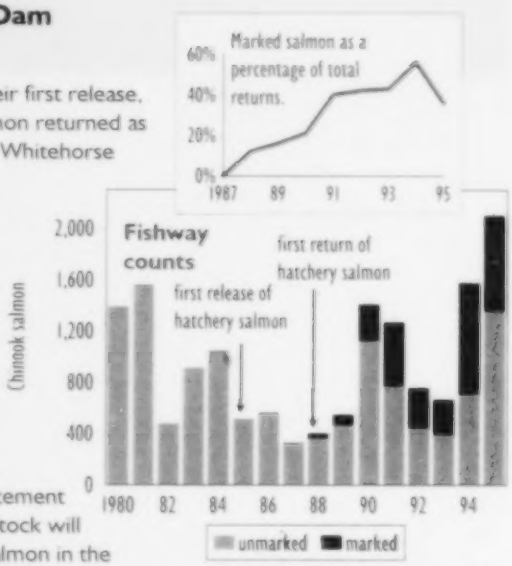
In the Yukon, activities such as mining and road construction often occur on small streams that are not used by adult fish for spawning but are important for juvenile salmon and freshwater fish. These streams have little capacity to dilute effluents and the streambed and floodplains are easily damaged.

Placer mining affects fish habitat by disrupting streams and releasing sediment into waters. High loads of sediment in streams have several types of effects: the water becomes murky and light needed for plant growth does not penetrate to the stream bottom; sediment settles and changes the nature of the streambed; and, the sediment affects the health, behaviour or reproductive capabilities of fish and aquatic invertebrates.

Yukon creeks that have been placer-mined for many years no longer provide habitat for salmon and many are also unsuitable for other species of fish. A major study of the effects of Yukon placer

Figure 4.11
Whitehorse Rapids Dam Fishway counts

In 1988, three years after their first release, hatchery-raised chinook salmon returned as spawning adults through the Whitehorse Rapids Dam Fishway. Subsequent years have seen an increase in the percentage of hatchery-raised salmon compared to the wild salmon stocks. While this meets the objective of ensuring that the numbers of returning salmon are not reduced by the dam, there are concerns that the trend toward replacement of wild stock with hatchery stock will reduce genetic diversity of salmon in the Yukon River upstream of Whitehorse. Studies continue.



Note: each year a portion of hatchery releases are marked with an adipose fin clip.

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Wildlife Protection

Yukon Territorial Council amended the Game Ordinance:

- set closed season on fur-bearing animals;
- full protection of little brown cranes, sandhill cranes, whooping cranes, swans and curlews;
- power to license guides, game market hunters and meat sellers;
- law applied to First Nations as well. It was not strongly enforced.

mining on fish, completed in 1992 concluded that existing regulations were not stringent enough to protect fish habitat from the effects of sediment released in placer effluent. New standards under the federal Fisheries Act (the Yukon Placer Authorization) have been phased in. The Authorization sets limits for the amount of sediment which can be released in placer effluent to any stream. It also designates Yukon streams as one of four types, depending on fish use. Each stream type is assigned a sediment discharge standard and has set requirements for stream rehabilitation following mining. In some locations, fish habitat values have been deferred to allow mining to proceed.

The main effects of hardrock mining are related to long-term discharges of low levels of metals, releases or spills of chemicals used in ore processing and disruption of streams through dams, diversions and mine development. Alterations to fish habitat are documented for the Faro and Elsa areas where mining has occurred for many years. In both areas, water downstream of the mines contains metals, mainly zinc, at levels above recommended guidelines for the protection of aquatic life.[3]

Inadequately-treated sewage affects the water quality by reducing oxygen levels, increasing nutrients and introducing toxic substances. Most of the smaller Yukon communities have no or limited seasonal discharges from sewage lagoons and do not affect fish habitat (see Section 2.2).

Whitehorse sewage is currently released year-round to the Yukon River from two lagoons. The level of treatment is not adequate to ensure that the effluent will not harm fish. An improved sewage treatment system has been approved and is under construction. Concerns were raised about the effects of the discharge from the new sewage lagoons. The plans call for an annual release of treated sewage in the fall. A study was carried out during the fall of 1993 to determine if lake trout or whitefish were spawning in the Yukon River downstream from the proposed outflow of the new system. No groupings of fish of either species were found, and it was concluded that the effects of the discharge on Yukon River fish will not be significant.

Activities associated with road construction, logging and residential growth can also affect fish habitat, mainly through increased erosion and disruptions to stream banks. Barriers that may block fish movement are created when roads are built across or beside streams. Culverts may be too small or have grades that are too steep, resulting in physical disruption of the waterway and flows that are too swift for fish to swim through.

On Snag road, just down here about 16 miles, they used to be full of grayling, but, what they did one year is put a culvert there and it shot way up in the air and the fish went down under that to another lake and they couldn't come back up again into the big lake to survive in the winter. So I guess they died off there. (Billy Blair, White River First Nation Elder)

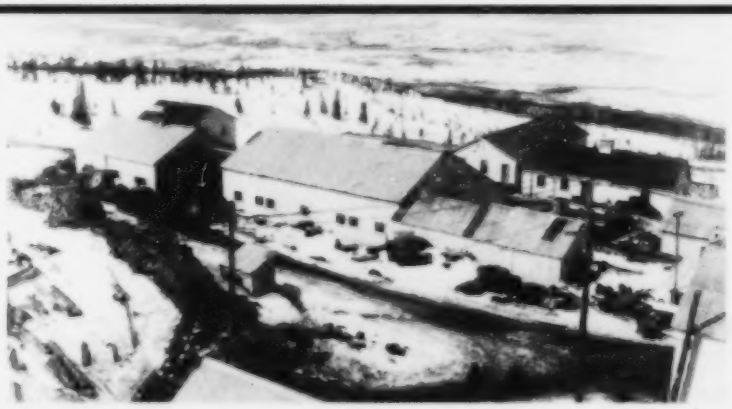
Fish habitat is protected through the federal Fisheries Act. Decisions about fish habitat are guided by the federal 'no net loss' fish habitat policy.[4] If habitat is physically altered, it must be restored or equivalent habitat created as compensation. Habitat loss through alteration of water quality is not permitted. To conform to this policy, mines must be decommissioned in a way that protects fish habitat in the long term from the effects of acid rock drainage or other influences on water quality.

Contaminants in Fish

Some contaminants, such as mercury and organochlorines, are found at low levels in air and water but build up to higher levels in aquatic food chains (Figure 4.12). These contaminants accumulate in certain tissues or organs of fish and affect the health of the fish or of people or other animals who eat the fish. Mercury and other metals are stored by special proteins in fish and they can build up to high levels in muscle or liver tissue. Organochlorines are stored in fish fat. Experiments have shown that contaminants stored in fish tissues often affect reproduction, growth or resistance to disease. These effects are often difficult to detect

1920 THE INTERIM YEARS

Electrical power at Keno Hill was supplied by a steam generator which consumed nine cords of wood every 24 hours.



Wernecke mining camp, Keno
Yukon Archives/Schellinger Coll.

in wild fish populations because so many other factors influence their health. Surveys of mercury and organochlorine levels in Yukon fish have been done to see if fish are safe for eating.

Mercury

The flooding of land through hydroelectric development releases natural mercury into water. Mercury from industrial emissions and landfill burning is also transported through the atmosphere and returned to the earth through dust and precipitation (see Section 1.3).

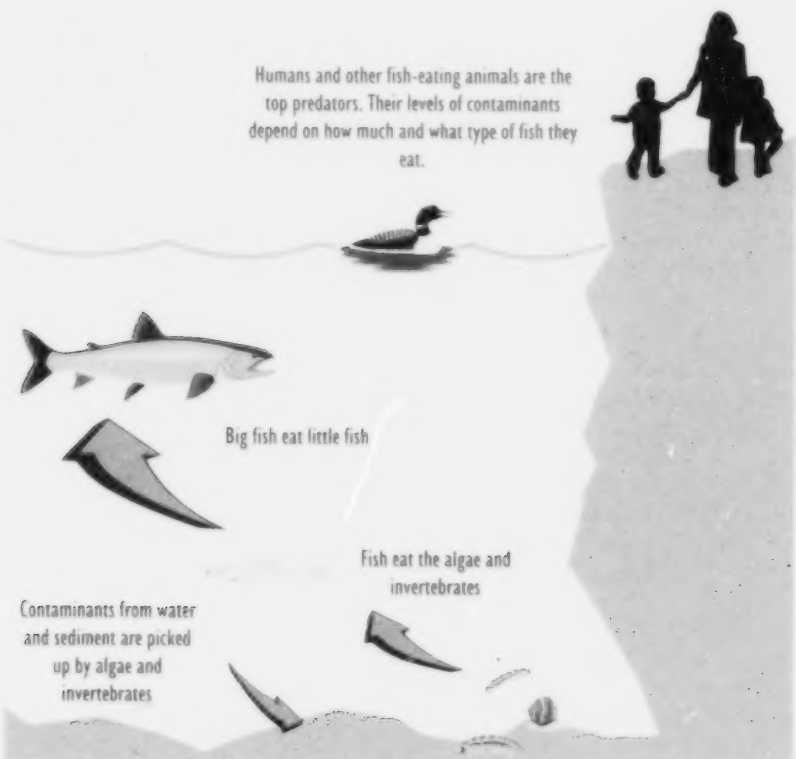
Following the discovery of high mercury levels in fish related to industrial and hydroelectric development in eastern Canada, and because of the associated health problems for aboriginal people who consume the fish regularly, national programs to survey mercury levels in fish and in human blood were undertaken in the late 1970s.

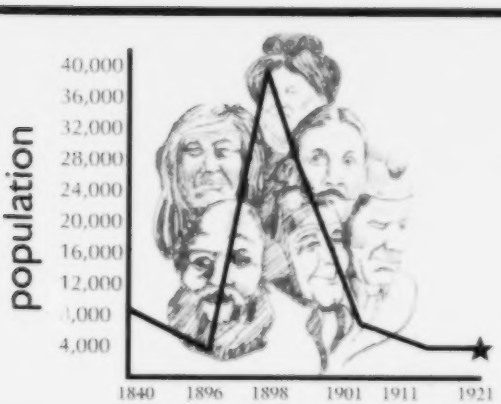
In 1977, fish from 30 Yukon lakes and rivers were sampled for mercury in muscle (flesh). Average levels of mercury in fish samples at each location were all less than 0.5 parts per million, the guideline for maximum acceptable level for mercury in fish.[5] Of 280 fish tested, nine of the larger fish contained mercury over this limit, and a further 55 fish exceeded the 0.2 parts per million limit recommended by Health Canada for people who consume at least three fish meals per week.[6] Studies on mercury in human blood in Yukon communities showed that mercury blood levels were all low.[7]

During the summers of 1990 and 1991, the Yukon government conducted tests on lake trout, northern pike and whitefish from six Yukon lakes. This study was prompted by concerns that the flooding of land by dams at Aishihik and Mayo Lakes might have increased mercury levels in fish. Average levels of mercury in all but one of the 14 sample sets were within the 0.5 parts per million

Figure 4.12
How contaminants build up in aquatic food chains

Some types of contaminants, including mercury and organochlorines, tend to move from water and sediment into plants and animals. Because these contaminants either do not break down or break down very slowly, they accumulate in each creature over its lifetime. Each predator 'collects' the contaminant accumulation stored in the prey that it eats. The contaminants then become more and more concentrated the higher up the aquatic food chain.


Humans and other fish-eating animals are the top predators. Their levels of contaminants depend on how much and what type of fish they eat.
Big fish eat little fish
Fish eat the algae and invertebrates
Contaminants from water and sediment are picked up by algae and invertebrates



[My husband] *gets license to get meat and sells meat. Every week he's supposed to bring two quarters* [of moose] *for the school.*
— Angela Sidney, Tagish Elder

mining on fish, completed in 1992, concluded that existing regulations were not stringent enough to protect fish habitat from the effects of sediment released in placer effluent. New standards under the federal Fisheries Act (the Yukon Placer Authorization) have been phased in. The Authorization sets limits for the amount of sediment which can be released in placer effluent to any stream. It also designates Yukon streams as one of four types, depending on fish use. Each stream type is assigned a sediment discharge standard and has set requirements for stream rehabilitation following mining. In some locations, fish habitat values have been deferred to allow mining to proceed.

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1920

THE INTERIM YEARS

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Weinecke mining camp, Keno
Yukon Archives/Schellinger Coll.

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Mercury

The flooding of land through hydroelectric development releases natural mercury into water. Mercury from industrial emissions and landfill burning is also transported through the atmosphere and returned to the earth through dust and precipitation (see Section 1.5).

Following the discovery of high mercury levels in fish related to industrial and hydroelectric development in eastern Canada and because of the associated health problems for aboriginal people who consume the fish regularly, national programs to survey mercury levels in fish and in human blood were undertaken in the late 1970s.

In 1977, fish from 50 Yukon lakes and rivers were sampled for mercury in muscle (flesh). Average levels of mercury in fish samples at each location were all less than 0.5 parts per million, the guideline for maximum acceptable level for mercury in fish.[1] Of 280 fish tested, nine of the larger fish contained mercury over this limit, and a further 55 fish exceeded the 0.2 parts per million limit recommended by Health Canada for people who consume at least three fish meals per week. Studies on mercury in human blood in Yukon communities showed that mercury blood levels were all low.

During the summers of 1990 and 1991, the Yukon government conducted tests on lake trout, northern pike and whitefish from six Yukon lakes. This study was prompted by concerns that the flooding of land by dams at Aishihik and Mayo Lakes might have increased mercury levels in fish. Average levels of mercury in all but one of the 12 sample sets were within the 0.5 parts per million

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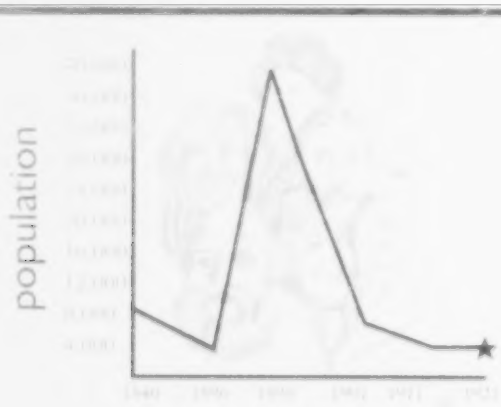
Some types of contaminants, including mercury and organochlorines, tend to move from water and sediment into plants and animals. Because these contaminants either do not break down or break down very slowly, they accumulate in each creature over its lifetime. Each predator collects the contaminant accumulation stored in the prey that it eats. The contaminants then become more and more concentrated the higher up the aquatic food chain.

Humans are also fish-eating animals on the top predators. Their levels of contaminants depend on how much and what type of fish they eat.
Big fish eat little fish
Fish eat invertebrates and invertebrates
Contaminants from water and sediments are passed up by algae and invertebrates



guideline. An additional two sample sets exceeded the 0.2 parts per million guideline for heavy fish consumers. The three sample sets with higher averages were all of large lake trout. The study showed that the two lakes with dams did not have higher levels of mercury than lakes without dams. These Yukon dams make use of natural lakes as reservoirs and much less land has been flooded than in areas of Canada where mercury problems in fish have resulted from dams.

All I think about is contaminated fish these days. Olden days you never think about fish, what is in them. Today we're scared. Traditional food are really very important for Indian people... If we feel that contaminated air is coming from other parts of the world, my question to you is, how are we going to stop it?

Roddy Blackjack, Carmacks Little Salmon First Nation Elder

Organochlorines

Fish from Lake Laberge were tested for the presence of organochlorine contaminants in 1990 and 1991. The results were unexpected – surprisingly high levels of toxaphene, DDT and PCBs were found in some fish tissues. Health Canada reviewed the sampling results and advised Yukoners to limit consumption of the livers of burbot (ling cod) and the flesh of lake trout from this lake. This advisory was based on the concentrations of toxaphene found in the fish. The advisory had an immediate effect on people in the Yukon and northwestern British Columbia, particularly on the Ta'an Kwach'an First Nation which traditionally relies on fish from Lake Laberge and sees burbot livers as a highly-prized food. The small commercial fishery in the lake closed and the non-native domestic food fishery was reduced.

In response to growing concern about contaminants in fish, a program of sampling and research was initiated through the federal Arctic Environmental Strategy. Studies on past use and disposal of organochlorines and testing of air, water, lake sediments and fish were carried out from 1991 to 1995. Results indicate that most of the organochlorines measured in fish enter local ecosystems from long range atmospheric transport (see Sections 1.3 and 2.2).

Results of surveys of organochlorine levels in three species of Yukon freshwater fish are shown in Figure 4.13. Low levels of organochlorines were detected in samples from most locations, and toxaphene was the main contaminant in most samples. The amounts of organochlorines varied greatly among fish species. Fish that are low in fat, such as northern pike, and fish feeding on

What are Organochlorines?

Organochlorines are a group of synthetic chemicals containing carbon and chlorine, used as pesticides or industrial chemicals. Particular properties of these chemicals make them act in a certain way when they are released to the environment:

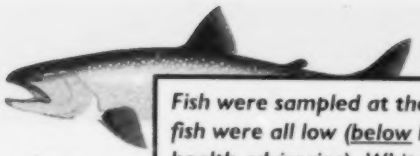
- they persist, breaking down only very slowly in the environment;
- they build up in fatty tissues; and,
- they magnify as they move up the food chain.

Many organochlorines have been linked to reproductive or growth problems and have been shown to cause cancer in animals in laboratory tests. The three organochlorines that are highest in Yukon fish samples are toxaphene, PCBs and DDT. Toxaphene and DDT are pesticides, banned in Canada but still used in some countries. PCBs are industrial oils now banned for production and being phased out of use in Canada and most other countries.

If we were out of moose meat all we had to do just go out in the bush and get whatever we wanted. There were a lot of grouse, a lot of rabbits, a lot of gophers. People up here eat gophers, because they're different type of gopher up here . . . They are not like prairie gophers at all. These are edible up here. They're a real delicacy to a lot of people. There's a lot of small game we could go out and get. A lot of us fished. We didn't have a butcher shop to run to all the time.

— Annie Geddes, Ta'an Kwach'an Elder

Figure 4.13
Organochlorines in Yukon freshwater fish, 1990-1994



Many Yukon lakes and river locations have been tested for organochlorine contaminants in fish since 1990. Levels of these contaminants vary from lake to lake, but are consistently very low in whitefish.

Fish were sampled at these locations. Contaminants in fish were all low (below levels that have resulted in health advisories). Whitefish, lake trout and burbot were the most common fish sampled.

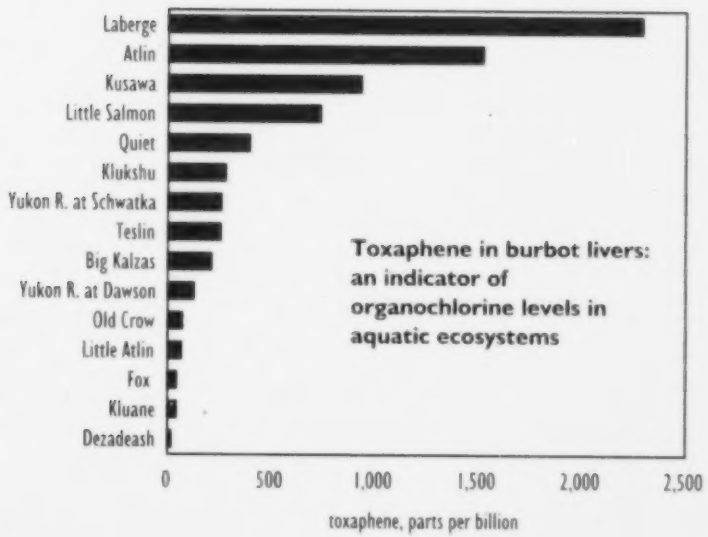
Lakes			*Rivers*
Aishihik	Fox	Little Salmon	Old Crow
Bennett	Frances	Marsh	Porcupine
Big Kalzas	Kathleen	Mayo	
Braeburn	Kloo	Quiet	Yukon River
Dezadeash	Kluane	Squanga	at Schwatka Lake
Dragon	Klukshu	Tagish	
Ethel	Kusawa	Teslin	Yukon River
Fish	Little Atlin	Wellesley	at Dawson City

Contaminant levels in some fish in these three lakes were higher than in fish from other Yukon locations.

- **Lake Laberge:** levels of organochlorines were generally two to ten times higher than at other lakes. Past local use and disposal of DDT and PCBs may have contributed to contaminant levels in Laberge fish. Toxaphene, however, is considered to be from atmospheric deposition. Studies show that contaminants become concentrated through the food chain in this lake. Health Canada recommends eating no Laberge burbot livers and limiting consumption of lake trout because of toxaphene levels. All other fish are safe to eat.

- **Atlin Lake:** the level of toxaphene in burbot livers was close to the Lake Laberge level, while other organochlorines in burbot, and all organochlorines in lake trout and whitefish, were low. Toxaphene in Atlin burbot is considered to be from atmospheric deposition. Health Canada advises that all Atlin Lake fish are safe to eat, although consumption of burbot livers should be limited because of toxaphene levels.

- **Watson Lake:** DDT levels in lake trout and whitefish were almost ten times higher than in other Yukon lakes, while all other organochlorine levels were very low. High DDT in fish is probably a legacy of past use and disposal of DDT around the lake. Health Canada advises that Watson Lake fish are safe to eat.



The variation in levels of toxaphene is probably related to differences in the ecology of the lakes. Because burbot are predators and because their livers are high in fat, burbot livers accumulate higher levels of organochlorine contaminants than other fish species and tissue types. This makes them good indicators of contamination from organochlorines from atmospheric deposition.

Bars represent average wet weight concentrations of toxaphene at each location.

invertebrates, such as arctic grayling and whitefish, had very low or non-measurable levels of organochlorines.

Organochlorine levels in each species of fish also varied from lake to lake. This variation is related to differences in the food chains in the lake. For example, lake trout eat mainly fish in some lakes and mainly invertebrates in other lakes. Those that eat fish accumulate higher levels of organochlorines than those that eat invertebrates. Lake Laberge lake trout eat more fish and have more fat and higher organochlorine levels than lake trout in other Yukon lakes.[8] Differences in climate and in physical and chemical properties among the lakes may also contribute to the variation in toxaphene levels.

In 1993, adult salmon were tested from three locations in the Yukon. Levels of organochlorines were consistently low in sockeye from Klukshu, chinook from Klukshu and Whitehorse, and chum from the Porcupine River. Salmon accumulate organochlorines mainly from the ocean where they spend most of their lives, rather than from Yukon lakes and rivers. Toxaphene, the main organochlorine detected, ranged from nine to 43 parts per billion in samples of salmon flesh. This is similar to the range of toxaphene levels in Yukon whitefish.

4.3 Wildlife and Wildlife Habitat

The decline and extinction of many species of wildlife is becoming increasingly evident world wide. Species decline can be a natural process, but increasingly researchers point to human activities as the root cause; specifically, activities that change the ecosystems upon which animals depend.

Biological diversity cannot be maintained on a regional basis. There are many global factors that could negatively affect Yukon wildlife. Long range transport of contaminants, global warming, reduction of old growth forests and wetlands, and ocean pollution cannot be controlled by one jurisdiction.

The number of vulnerable species across the country is cause for concern with regard to the continued biodiversity of Canada's wildlife. In the 19th century, overharvesting was the major factor in the decrease of wildlife populations in Canada. In recent years, the major threat to wildlife is land alteration. The disappearance of wetlands, reduction of old growth forests, changes in vegetation due to development, and introduction of toxic materials alter the ecosystem to such an extent that many species begin to decline, or simply cannot survive.

The Great Lakes and St. Lawrence regions, the most populated areas in Canada, are home to the greatest number of endangered or threatened species, while fewer species are in trouble in the Arctic and Boreal zones of the Yukon. In comparison to the urban regions of Canada, the Yukon has retained most wetland areas, as well as extensive natural and wilderness areas. The challenge is to recognize the increasing threats of both incremental development and a steadily growing human population to Yukon wildlife, then to take steps to maintain the biological diversity of these northern ecoregions.

Wildlife Habitat

The areas used for critical, seasonal life functions by a given species are known as key wildlife habitats. Many different species may use these key areas at the same time each year and animals often gather in relatively large numbers in key habitats. If these habitats are destroyed, or if the animals using them are disturbed, populations are liable to decrease.

The Yukon government is carrying out an inventory of the location, distribution, and abundance of key habitats for the legally harvested and protected wildlife species (Figure 4.14). Known key Yukon habitats have been mapped and a report describing the habitat areas is underway.

This inventory information has been gained primarily through observing animal locations at certain times of the year, but is not based specifically on the

1924 THE INTERIM YEARS

Lewes River Dam Constructed

White Pass & Yukon Route completed the Lewes River (Marsh Lake) dam on the Yukon River, replacing an older structure. Each spring the dam was opened to flush ice out of Lake Laberge. Lowered water levels and siltation affected the chinook salmon.

Yukon Archives/MacBride Museum Coll.

characteristics that make the habitat useful. Emphasis is now being placed on determining what factors make certain habitats 'key' and on evaluating habitat quality and capability. Studies are planned for 1995/96 to analyse caribou and moose habitat requirements in the Aishihik, Carcross and Watson Lake areas.

The habitat information will be used by industry and land managers in land use planning, in reviewing land use permits and in identifying protected areas. It may also aid in the protection of key habitats from the effects of development activities such as mining, forestry, transportation, and agriculture.

Land development is known to be reducing the available habitat for a number of wildlife species; however, the effects of development on habitats in the Yukon are yet to be usefully documented.

In the four completed Yukon First Nation Final Agreements, governments and First Nations have agreed to the special management of several key habitats to ensure protection of the area. The most extensive area designated to date is the Old Crow Flats. Habitat can also be protected through carefully planned mitigation. Further legislation for the protection of habitat is being developed.

Protecting Habitat: Old Crow Flats Special Management Area

Old Crow Flats is a 600,000 hectare plain pocked by over 2,000 wetlands, varying in size from one half to 4,700 hectares. The area is important as a breeding and moulting ground to 500,000 waterbirds. The waterfowl, muskrats, and other wildlife of the Flats are of great importance to the Vuntut Gwitchin people of Old Crow, located south of the Flats at the confluence of the Old Crow and Porcupine rivers.

In 1982, Old Crow Flats was designated as a wetland of international importance under the RAMSAR Convention. Under the terms of the 1995 Vuntut Gwitchin Final Agreement, Old Crow Flats was designated as a Special Management Area, with the northern portion of the Flats being included within the new Vuntut National Park. Under the land claims agreement, this important habitat for waterfowl and furbearers will be managed cooperatively by the Vuntut Gwitchin First Nation and federal and Yukon government agencies.

Old Crow Flats will be managed to maintain the integrity of the area as one ecological unit, with the conservation of fish and wildlife and their habitats, and the protection of current and traditional use by the Vuntut Gwitchin as guiding principles. A three-year study of waterfowl and wetland habitats on the Flats is underway. Information from this study will be used in the development of a management plan for the Old Crow Flats to be prepared jointly by government and the Vuntut Gwitchin First Nation.

Figure 4.14
Key habitats for selected Yukon wildlife

continued...

Early Mosquito Control

The first organized mosquito control project in Whitehorse involved pouring oil in snow-melt pools containing mosquito larvae. This method of mosquito larva control was used until the late 1940s.

Johnnie Johns surrenders Indian status to obtain a chief guide licence.

Figure 4.14 (continued)

Species	Key Habitats
elk	mineral licks year-round distribution
wood bison	mineral licks year-round distribution
muskox	mineral licks year-round distribution
grizzly bear	major feeding areas
polar bear	denning areas
fox	denning sites
wolf	

continued...

Big Game Hunting

Because of its low human-to-animal ratio, the Yukon has traditionally been an area where human lifestyle could be closely dependent on the land. Hunting is important to many Yukoners as a means of subsistence and as an opportunity to spend time on the land. There has, however, been a slight downward trend in the number of big game licences sold to Yukoners, from a peak of 5,246 in 1982 to 3,724 in 1994. This trend is for non-native hunters only, as Yukon First Nation hunters do not require licences. Figure 4.15 shows which species of large mammals are hunted by Yukon and non-Yukon licensed hunters.

Changing Attitudes Towards Wildlife

In the past decade or so there has been an increased appreciation for wildlife, not in terms of its use to humans, but with a value in its own right. The heightened interest in wildlife appreciation worldwide is likely related to increasing urbanization and the incremental loss of wildlife species in the more populated regions of the world.

Wildlife harvesting data are compiled regularly, but there is only limited information on trends in wildlife viewing or other non-consumptive activities relating to wildlife. The opportunity to view

Development and Habitat

Development can take place within critical habitat areas without negatively affecting wildlife. In 1988, Curragh Resources Inc. planned the expansion of its mine near Faro, Yukon. The initial development proposal would have blocked the summer-to-winter migration corridors of the Mt. Mye Fannin sheep population and negatively affected a mineral lick area. (Fannin sheep are an uncommon colour form of thinhorn sheep.) Together, Curragh Resources, Yukon Renewable Resources, the Ross River Dena Council, and the residents of Faro developed a sheep management plan. Hunting was closed, and the sheep were studied to understand their use of the area. The resulting mitigation plan included a buffer strip around the open pits, new trails for the sheep including a ramp to enable them to cross the haul road more easily, a realignment of the existing Blind Creek Road away from the sheep winter range and around the mineral lick area, habitat enhancement work, including brush cutting and burning, and the establishment of a viewing area and photography blind to enable residents and visitors to observe the sheep without disturbing them.

The sheep population is currently stable at approximately 80 animals, demonstrating that mining development and a wildlife population can co-exist, and may in fact create benefits such as wildlife viewing opportunities. The mine has recently changed ownership and government has initiated discussions with the new owners in order to continue the sheep mitigation efforts.

1929 THE INTERIM YEARS

Wolf Bounty

Yukon Territorial Council passed an ordinance to pay bounty on wolves and coyotes. Ineffective and costly, the bounty was withdrawn in the mid 1930s. At about the same time, the poisoning of varmint species was prohibited.

Yukon Archives/Claude Tidd Coll.

wildlife is considered to be one of the factors in the increased number of visitors to the Yukon from overseas. The 1994 Visitor Exit Survey shows that wildlife viewing is one of the reasons tourists travel to the Yukon.

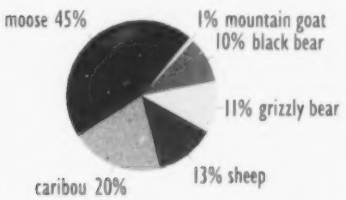
Parks Canada and the Yukon government have increased their efforts in managing wildlife for non-consumptive purposes. The Yukon government has two nature interpretive centres, and the use of these facilities is steadily increasing (Figure 4.16). Government and non-government agencies are increasingly involved in wildlife viewing through such activities as educational and interpretive programs.

Trends in Selected Mammal Species

Information on mammal populations is based on scientific studies and surveys or is derived from harvest records and related data. Scientific data compiled by government biologists are supplemented by traditional knowledge of First Nations' elders interviewed during the preparation of the State of the Environment Report. Science-based and traditional knowledge often tell the same

Figure 4.15
Hunter effort and big game harvest

This graph shows estimates of the percentage of time spent by licensed hunters hunting each species. Data are averages, 1989-93.



Licensed 1994 big game harvest

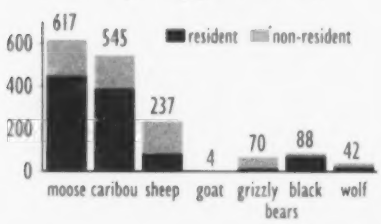


Figure 4.16
Attendance at Yukon nature interpretive centres

Attendance is increasing at two Yukon interpretive centres. Low 1995 attendance at the Dempster Centre along the Dempster Highway may be related to forest fires and road closures. Swan Haven opened in 1992 at McClintock Bay near Whitehorse.

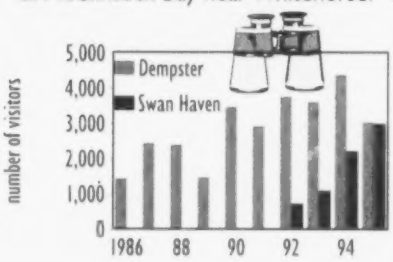


Figure 4.14 (continued)

Species **Key Habitats**

year-round distribution (high density areas)

beaver

year-round distribution (high density areas)

muskrat

year-round distribution

seal

migration corridor

beluga whale

summer range
fall range

bowhead whale

continued...

THE INTERIM YEARS 1930s

1936 Elsa mill began production at 150 tonnes a day.

1937 Territory outlawed hunting from aircraft.

1937 No furs were traded at Herschel Island. The Hudson's Bay Co. decided to close the Herschel Island trading post.

1938 The law allowing unrestricted use of caribou for feed at fur farms was repealed.

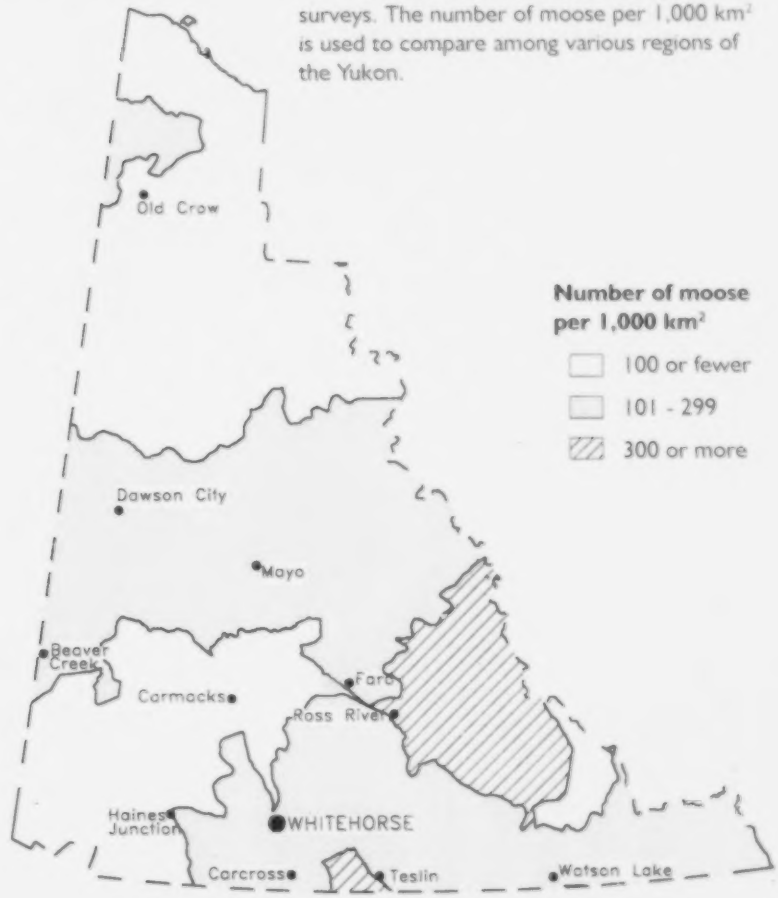
Inuit schooners and HBCo. warehouse at Herschel Island, 1930.
Yukon Archives/Finnie Coll.

Figure 4.14 (continued)

Species	Key Habitats
ducks, geese, swans	spring staging, summer nesting, sumer moulting, fall staging
raptors	summer nesting areas
sharp-tailed grouse	year-round distribution
shorebirds	summer nesting, brood rearing, fall staging
seabirds	summer nesting, fall staging
gulls and terns	summer nesting, fall staging

Figure 4.17
Estimated 1994 moose densities

Moose densities are estimated through aerial surveys. The number of moose per 1,000 km² is used to compare among various regions of the Yukon.



story, but sometimes they differ. Wildlife biologists report that populatons of game species are considered stable on a territory-wide basis, although localized fluctuations occur. First Nation elders report that in most areas there are far fewer caribou and in some areas fewer moose and small game animals such as ground squirrels (gophers) than 40 to 50 years ago.[1]

Fish Rack
Yukon Archives/Tidd Coll

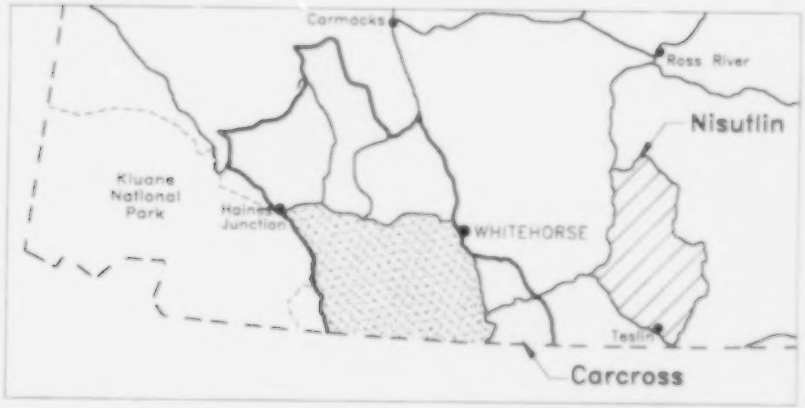
The Family Eddy

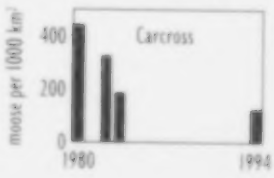
Every family move to their own eddy along the river where they can catch salmon and dry it for the winter. They dry fish for about one month. They catch maybe much as ten fish a day, twenty fish a day, maybe. That adds up fast when you dry it. That they have to divide it between three or four, five families, each camp. One eddy to supply all these people.

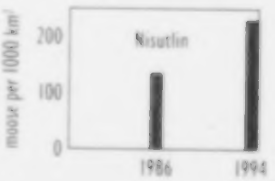
— Roddy Blackjack, Carmacks Little Salmon Elder

Figure 4.18
Moose densities in southwest Yukon

The general area where densities have declined is shown in the map. The graphs show two contrasting areas - Carcross, where moose populations are declining, and Nisutlin, a more remote area with less road access, where the moose population has increased.







General area of declining moose densities (1980-1990)
Areas stabilized or moderately increasing (1990-1994)
Area where severe decline in moose population led to recovery program (1990-1994)
Area with increasing moose densities

Moose

Moose are distributed throughout the territory (Figure 4.17). Their populations are considered stable at an estimated 60,000. Moose are the most popular big game species in the Yukon, prized for their meat and for their trophy potential (Figure 4.15). The species is also important for wildlife viewing.

Discussions with elders indicate that moose abundance has increased in some areas and decreased in others.[1] Elders spoke of successful annual hunts and past abundance of moose in some regions, such as Teslin. Other elders spoke of lower moose populations during their youth: *There wasn't many moose them days. We were down there [Donjek] in 1938, '37. There's very few moose. We hunt two weeks, never get a moose. There was lots of wolves. And we'd live on rabbits for two weeks.* (Dick Dickson, Kluane First Nation Elder)

Moose densities declined between 1980 and the early 1990s in the Haines Junction, Aishihik, Whitehorse North and Carcross regions (see Figure 4.18). These areas, which are easily accessed by road, came under high harvest pressure. For example, in Game Zone Seven (which includes Haines Junction), the 1979 harvest was 135 and in Game Zone Five, which includes the Aishihik area, the 1979 moose harvest was 100. These figures do not include the native harvest.

As a result of a combination of management programs and the declining moose populations, the harvests in Game Zone Seven declined to nine, and to 43 in Game Zone Five. From the 1980s to present, intensive management has been required in several areas in order to bring about recoveries. These management efforts resulted in a recovery of the moose population in the Haines Junction area. Results of the Aishihik recovery program are not yet available.

THE INTERIM YEARS

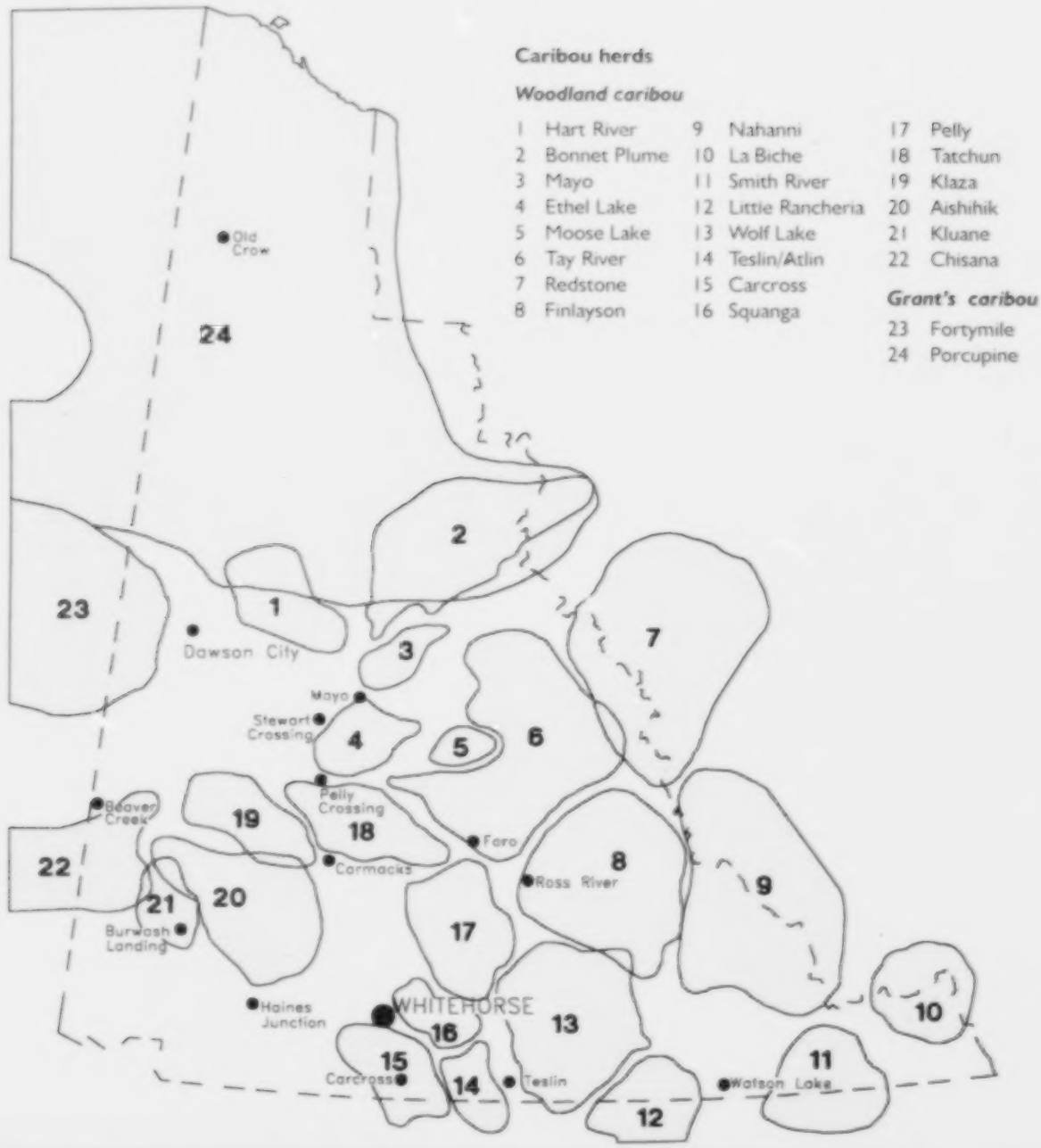
There used to be lots of fish there (Lower Laberge). I remember when I was a kid I used to help my dad fishing. They used to sell it to the steamboat. It was good fish. You can't sell polluted fish to the boats.
— Henry Broeren, Ta'an Kwach'an Elder

In contrast, the Nisutlin area, which has limited road access and is further from population centres, has experienced an increasing moose density from 1986 to 1994 (Figure 4.18). However, increased hunting from river access, if not carefully monitored and managed, could also reduce the moose population.

From 600 to 800 moose are harvested annually in the Yukon. This figure does not include the First Nation harvest. Assuming First Nation harvest equals the licensed harvest, the total annual Yukon moose harvest is estimated at 1,200, a level considered sustainable by wildlife managers. The moose harvest is significant in terms of a food supply for many Yukon residents.

With the settlement of land claims in the Yukon a new cooperative management regime will be established. This should lead to enhanced management over the long term.

Figure 4.19
Distribution of caribou herds in the Yukon



Caribou

There are 22 woodland caribou herds and two Grant's caribou herds, the Fortymile and Porcupine (Figure 4.19, Table 4b and Section 6.1). The total estimate for woodland caribou in the Yukon is 30,000 to 35,000. These small, isolated herds migrate relatively short distances between valley-bottom winter ranges and alpine summer ranges. Studies suggest animals do not move between herds even when ranges overlap.

The Fortymile Caribou Herd

In the early part of the century, the Fortymile caribou herd numbered in the hundreds of thousands and ranged as far west as Fairbanks and as far south as Whitehorse. The herd has been reduced to a mere remnant of its former size; its range has shrunk to a fraction of the original area (Figure 4.20).

The memory of this great herd remains with a few elders. Paddy Jim from the Champagne Aishihik First Nation remembers seeing the caribou herd at Champagne in 1938. *You could see that mountain there, just black, just moving caribou. And then when you drive your dogteam, you don't break trail. It's caribou trail all over. Even when you trap, you got to know where to set trap because caribou just kick it down. So many caribou. They came in every fall until March, then they move back north again. All of a sudden they just didn't come back. They never come back.*

Table 4b

Status and trends in populations of Yukon caribou herds

Woodland caribou herds

Stable herds

Herd	Population estimate	Comments
Ethel Lake	316	Small herds (under about 500) are considered vulnerable.
Moose Lake	211	
Little Rancheria	680	
Klaza	441	

Herds with unknown population trends

Herd	Population estimate
Hart River	1,200
Bonnet Plume	5,000
Mayo	no estimate
Redstone	5,000-10,000
Nahanni	2,000
LaBiche	400
Smith River	200
Teslin/Atlin	1,000
Pelly herds	1,000
Tatchun	300
Squanga	300

Stable to increasing herds

Herd	Population estimate
Tay River	3,760
Finlayson	5,960
Wolf Lake	1,250

Comments: all herds healthy.

Decreasing herds

Herd	Population estimate	Comments
Carcross	380	Vulnerable; comanagement underway with six First Nations.
Aishihik	900	Hunting closed; wolf reduction begun in 1993.
Chisana	900	Very poor calf recruitment in 1993.

Grant's caribou herds

Herd	Population estimate	Comments
Fortymile	22,000	Vulnerable population due to road access in range; only small portion of herd winters in the Yukon.
Porcupine	160,000	Range also in Alaska; vulnerable due to potential for activity in calving grounds (see Section 6.1).

A Dawson elder described the caribou herd she saw as a 10-year old. *The caribou used to float by Dawson when we were kids. The ice would go out, a big event. Everybody would take a holiday, and then we would see all these caribou, trying to cross the river, and getting stuck on the ice. There would be hundreds of them going by. But they say they don't do that any more.* (Rowena Flynn, Trondek Hwech'in First Nation Elder).

A 1933 account states that, *the big herd could be smelt from at least 20 miles away on a hot day,*[2] and others describe a vast migration of caribou that would halt boats on the Yukon River.

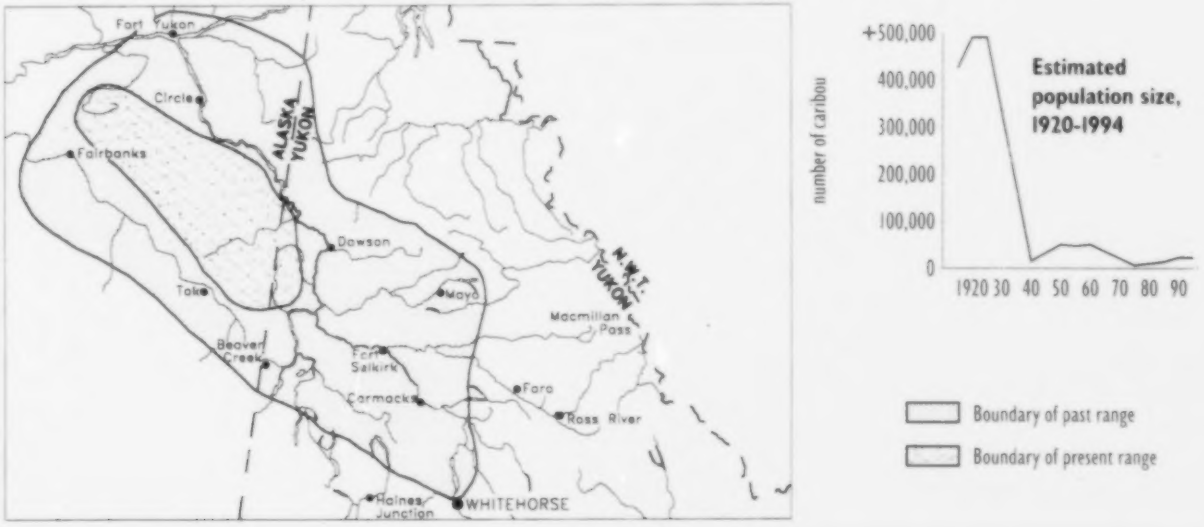
The herd was so abundant, it was the centre of an ecological system, feeding a pyramid of other animals, supporting the aboriginal people and later, the explorers and gold miners. The first noticeable decline of the herd occurred during the Gold Rush, when the caribou were harvested by the thousand to feed the influx of people. While most of the harvest was for food, there is evidence of misuse. As recently as the 1960s, caribou were killed either for sport or body parts, and left to rot on the Top of the World Highway.

In the past 90 years, the herd population has fluctuated, reaching a dangerous low of 5,000 in 1975 and withdrawing into the Alaskan portion of the range. In the past 20 years, the herd has made a minor recovery and currently numbers approximately 20,000.

Harvest remains a significant threat to the herd. In Canada, the harvest is relatively low because the caribou migrate into the Yukon only in late fall when road closure prevents access to the herd. The herd ranges primarily in Alaska, where year-round roads provide easy access for sport hunters. Alaska allocates two per cent of the herd each year for sport hunting. That harvest is approximately 400, supplemented by the estimated subsistence hunt of 100. Since

Figure 4.20
Past and present ranges and estimated population size of the Fortymile Caribou Herd

In the early 1900s this herd occupied an area that included most of southwest Yukon. Today the herd is only found in a small area west of Dawson City.



1942

WORLD WAR II

The Alcan

During this peak year of construction, 15,900 people and 11,107 pieces of machinery are at work on the Alaska Highway.

1989 roughly 2,500 caribou have been removed from the herd by hunting. This level of harvest could threaten the viability of the herd and, combined with natural predation, may precipitate another decline or prevent a recovery.

The habitat of the Fortymile caribou herd remains relatively intact, and could support its previous population. Yukon biologists believe that the herd needs to reach a minimum of 60,000 to begin a true recovery. Only through effective cooperative management between Yukon and Alaska wildlife agencies, particularly in resolving the issue of harvest, can the caribou number the same hundreds of thousands that inhabited the Yukon a century ago.

Sheep

There are an estimated 22,000 thinhorn sheep in the territory – more than in any other part of Canada. They are considered stable, with localized, short-term fluctuations in numbers resulting from natural events. These natural fluctuations are thought to be the main influence on population changes. For example, a poor spring and late vegetation growth in 1981-82 caused a lamb crop failure in many areas, resulting in fewer large rams in these areas now. Such events, both good and bad, balance out over the years and throughout the regions. Harvest is still monitored, but sheep surveys occur irregularly.

Mountain Goats

Yukon goat populations are considered stable to increasing with an estimated 1,700 animals. They are concentrated in the southern third of the territory (primarily in the Kluane area) at the northern limit of their range. Goats are a prime example of a Yukon species that would be positively affected by a global warming trend. Because the Yukon is at the northern limit of their range, an increase in temperature resulting in an earlier, milder spring would likely extend the range of the mountain goats to the north. The harvest is kept very low and, since goat numbers are difficult to determine, harvest is monitored for any indications of population decline. Additional monitoring of populations is done on an ad hoc basis.

Mountain goats have been reintroduced to Mt. White, near the junction of the Alaska Highway and the Atlin Road. The goats that previously inhabited the mountain disappeared following road development in the area. In 1983 and 1984, to make use of this available habitat and provide viewing opportunities, the Yukon Fish and Game Association and Renewable Resources moved 12 goats to Mt. White from the Kluane Game Sanctuary. In July 1992, the population was estimated at 33 animals. Eight additional goats from the Yukon Game Farm were released on the mountain. No surveys have been conducted since, but the goats are sighted often and are presumably doing well.

Wolves

The vast, relatively uninhabited areas of the Yukon provide a home for many species that are threatened or vulnerable elsewhere in the world. The grey wolf is one such species. Viewed at risk internationally by the Convention for International Trade in Endangered Species (CITES), wolf populations in the Yukon are healthy and stable. There are about 4,500 wolves in the Yukon's 23 ecoregions. This number is based mainly on snow-tracking studies. About 100 wolves are harvested annually through trapping or hunting.

About one-third of the Yukon has been surveyed for wolf population density (number of wolves per 1000 km^2). These population densities reflect the relative abundance of the wolf's prey species, mainly moose, caribou and mountain sheep. Densities are lowest in the Carmacks-Nisling area and the northern Yukon. They are highest in the Teslin Burn area. In other areas the densities average about eight to ten wolves per 1000 km^2.

The wolf is important to Yukon First Nations. It represents one of the two matrilineal clan systems; the other is crow. The wolf appears in many traditional stories, illustrating its strong association with First Nations.

Wolf research has been concentrated in the Yukon North Slope, and in the Finlayson Lake and Kluane areas. Much of this has

WORLD WAR II 1942

Road construction and its associated activity changed the annual cycle and settlement patterns for native people. Many families could no longer maintain their subsistence lifestyle.

US Army personnel allowed to buy hunting licences at $1 each.

Yukon Archives/MacBride Museum Coll

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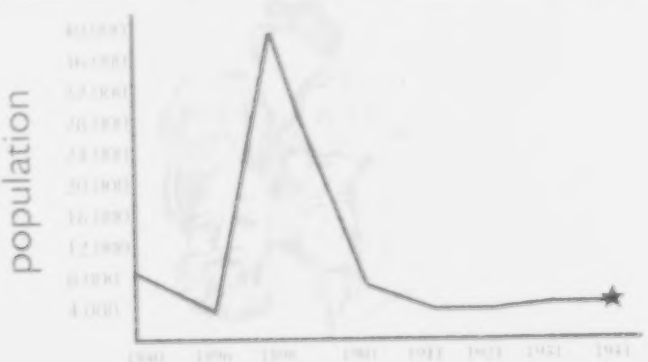

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The vast, relatively uninhabited areas of the Yukon provide a home for many species that are threatened or vulnerable elsewhere in the world. The grey wolf is one such species. Viewed at risk internationally by the Convention for International Trade in Endangered Species (CITES), wolf populations in the Yukon are healthy and stable. There are about 4,500 wolves in the Yukon's 25 ecoregions. This number is based mainly on snow-tracking studies. About 100 wolves are harvested annually through trapping or hunting.

About one-third of the Yukon has been surveyed for wolf population density (number of wolves per 1000 km²). These population densities reflect the relative abundance of the wolf's prey species, mainly moose, caribou and mountain sheep. Densities are lowest in the Carmacks-Nisling area and the northern Yukon. They are highest in the Teslin Burn area. In other areas the densities average about eight to ten wolves per 1000 km².

The wolf is important to Yukon First Nations. It represents one of the two matrilineal clan systems; the other is crow. The wolf appears in many traditional stories, illustrating its strong association with First Nations.

Wolf research has been concentrated in the Yukon North Slope, and in the Finlayson Lake and Kluane areas. Much of this has

1942

WORLD WAR II

Road construction and its associated activity changed the annual cycle and settlement patterns for native people. Many families could no longer maintain their subsistence lifestyle.

US Army personnel allowed to buy hunting licences at $1 each.

Yukon Archives/MacBride Museum Coll.

focused on predator prey relationships and wolf population dynamics. About 300 wolves in 100 wolf packs have been radio-collared as part of these monitoring studies.

Concern about the effects of predation on declining woodland caribou has prompted two short-term wolf reduction programs in the Finlayson area and the Aishihik area in Kluane. Wolf numbers are reduced over five to seven years, along with hunting closures or restrictions, to help increase calf survival and recruitment rates. Results in the Finlayson area between 1983 and 1995 show increases in both wolf and prey populations, but ongoing monitoring is necessary to track long-term effects of the program. The Aishihik Caribou Recovery program was begun in 1993. Results will be reported in 1997.

Wolf control has been controversial from the outset, evoking strong support or passionate opposition from residents and nonresidents. Arguments on both sides reflect a mix of science, ethics and perceptions. Wolf management, including wolf control in the Aishihik area, is guided by the Yukon Wolf Conservation and Management Plan. The plan was written by a public panel and adopted by the Yukon Government in 1993. It calls for regular review periods and requires that wolf control in caribou and moose recovery programs be closely monitored. It also sets out guidelines for how wolf reduction is to occur. Historically, wolves have been regarded as a nuisance species, or managed only as part of efforts to sustain game populations. The plan recognizes the grey wolf as a species having value in its own right.

Grizzly Bears

Grizzlies inhabit the entire territory. Populations are stable at an estimated 6,000 to 7,000 bears. They are highly valued as indicators of the richness of Yukon's wildlife. Grizzlies are hunted annually, and no systematic population monitoring is carried out other than reporting of harvests (see Section 4.4).

Black Bears

The species is assumed stable, with an estimated population of 10,000. Wildlife biologists monitor the annual legal harvest and respond to concerns about nuisance bears (see Section 4.4).

Polar Bears

Polar bears are distributed along the southern edge of the arctic ice cap (see Section 4.4).

Furbearing Animals

Furbearer harvest is monitored annually on a trapline area basis throughout the Yukon. In addition, trappers complete a questionnaire to help determine population indices. Furbearers are considered to be stable or increasing. (Table 4c) The number of licensed trappers has decreased in recent years due primarily to a decline in world fur prices.

An eight year study on lynx, their habitat and the effect of trapping has recently been completed and is in the write-up

Table 4c

Population trends of selected furbearing species

Species	Trend	Comments on trapping
beaver	stable	not heavily harvested
coyote	stable	not heavily harvested
red fox	stable	not heavily harvested
lynx	recovery phase of cycle	key species for trappers. Interest fluctuates with market value
marten	increasing	key species
mink	stable	not a key species for trappers
muskrat	stable	not heavily harvested; most extensive population: Old Crow Flats

1942 WORLD WAR II

The Gravel Magnet

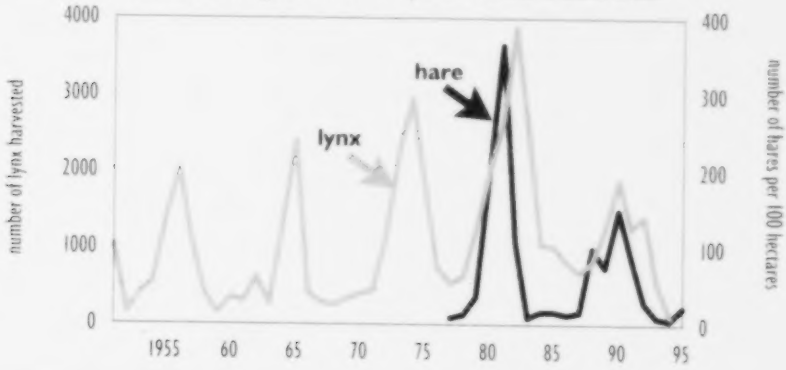
Lot of change after that. People just like they moved away from bush and they come to highway, everybody move to highway. People cut wood for army and some people work for them and highway.

— Stella Boss, Haines Junction

First Nations family on Alaska Highway
Yukon Archives/Ormbreck Coll. 90/52 #73

Figure 4.21
The snowshoe hare / lynx cycle

Snowshoe hare and lynx populations both fluctuate widely in cycles lasting several years. Since the hare is the lynx's main prey item, the lynx population moves up and down in response to the changing numbers of hares. The lynx data are based on Yukon-wide harvest statistics. Although harvest also varies with fur prices, it is a good indicator of population trends. The hare data are based on direct monitoring of hare density in the Kluane Lake area.



stage. Snowshoe hare habitat was studied in the Klondike Valley and the Klondike valley land use plan identified lynx habitat near Dawson City as needing protection.

The Hare Cycle

The snowshoe hare population in the Yukon follows a predictable cycle of approximately 10 years (Figure 4.21). This cycle has profound effects on many other Yukon species, the most prominent being the lynx, since hares are their major food source. This cycle also affects other species that are dependent on the hares for food, as well as alternate prey species. For example, coyotes and upland game birds tend to follow the same 10-year cycle. The current population lows for hare, lynx, grouse, coyote, and other species reflect the 1993-94 low trough of the hare cycle.

There should be an upswing in the next few years with the next peak in hare numbers expected around the year 2000.

Coyotes

Coyotes are a relatively new species in the Yukon. They expanded northward into the Yukon in the latter parts of the 1800s and by the early 1900s they inhabited the entire territory. Now they are relatively abundant in the territory. Both scavengers and predators, coyotes depend on a variety of food sources, but they are particularly affected by the hare cycle. When hares are at a low point, as in recent years, coyotes are increasingly seen in urban areas searching for a meal. This behaviour pattern should decline over the next few years as the hare population rebounds. Coyotes are adaptable, intelligent animals, and can become tolerant to human presence. Although coyotes are primarily nocturnal, they are often out during the day, which makes them a highly visible wildlife species.

Specially Protected Mammals

Through the Yukon Wildlife Act and regulations pursuant to the Yukon Act, several species in the Yukon are protected. The mammals named as Specially Protected Wildlife are: bison, elk, muskoxen, mule deer and cougar.

Bison

The wood bison became extinct in the Yukon approximately 1,000 years ago. As part of a national recovery plan, the bison is being successfully reintroduced into appropriate habitats in the territory. Population and productivity are monitored by aerial survey and by radio collar (see Section 4.4).

WORLD WAR II 1942

River a Dump

The U.S. Army moved the Whitehorse town dump downstream to the mouth of McIntyre Creek at its confluence with the Yukon River. Previously garbage was dumped on the bank near Moccasin Flats and occasionally pushed into the river. This was also the disposal method used at Dawson City. (The federal government and First Nations are still identifying and cleaning up wartime dump sites.)

Wapiti (Elk)

Elk were introduced to the Yukon in the late 1950s. The initial introduction of approximately 50 animals has been supplemented over the years and the current Yukon population is estimated between 120 and 150 elk. The species is thought to be vulnerable because of poor recruitment, habitat encroachment, and natural predation which is especially heavy among calves. There is also concern over occasional poaching activity. Monitoring of the species is sporadic.

Muskoxen

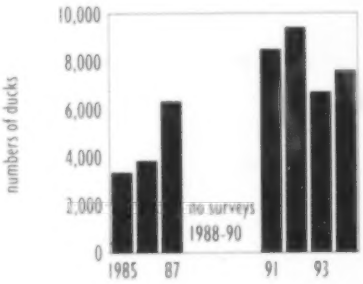
Muskoxen were hunted to extirpation in Alaska by the mid-1800s during the height of the whaling industry in the Beaufort Sea. Their past status on the Yukon North Slope remains uncertain. In 1969 they were reintroduced to northeastern Alaska and the population grew rapidly. Some of these animals have expanded their range and moved successfully into the Yukon North Slope. There is concern among northern Yukon and Mackenzie Delta subsistence hunters that the muskox population may expand rapidly and affect the caribou. The current Yukon muskox population is 150 animals (1995 survey); numbers and distribution will continue to be monitored.

Mule Deer

This species is at the northern edge of its range in the Yukon and is naturally variable. The population suffers occasional catastrophic declines due to extreme climatic conditions. Sightings are recorded to determine extent of range. No systematic monitoring of numbers occurs.

Figure 4.22
Total numbers of ducks on Needlerock Wetland

Conditions at the ducks' wintering grounds and at other wetland areas influence duck populations and distribution. Annual variations in duck numbers on Yukon wetlands are probably related to changing conditions on the Central Plains.



Cougar

Cougar are distributed sporadically through the south central Yukon.

Birds

Song Birds

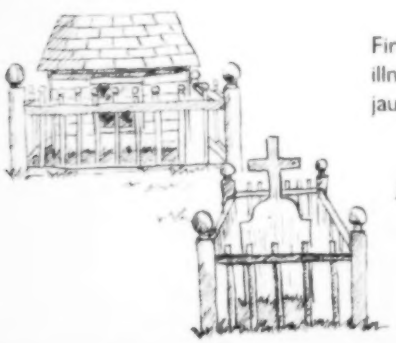
Little is known about the breeding status of song birds in the territory. There are 88 species scattered across the Yukon; many have limited distribution or spend only part of the year here. Many species winter in southern areas of the western hemisphere and local changes to bird populations may be the result of conditions elsewhere.

The Canadian Wildlife Service, in cooperation with other government agencies and volunteers, conducts annual breeding bird surveys at locations across the Yukon to determine population trends. This program requires several consecutive years of consistent data, so no trends are yet discernible. Bird productivity and survivorship is also recorded annually at a banding station as part of a North America-wide project to monitor song bird trends. The biggest threat to song birds in the Yukon is habitat loss. Recent work has focused on determining habitat requirements of forest birds in southern Yukon.[5]

Waterfowl

Thirty-four species of swans, geese and ducks inhabit the Yukon annually. Breeding pair surveys are carried out annually along three road corridors across the southern territory, in addition to a helicopter survey of the Needlerock wetland near Carmacks (Figure 4.22) and an aerial transect survey on the Old Crow Flats (see Section 5.1). Numbers of breeding waterfowl appear to be stable, although counts reflect decreasing numbers of non-breeding ducks utilizing Yukon wetlands. This is a result of lessening drought conditions on the Central Plains.

1942 WORLD WAR II



Death Rides the Highway

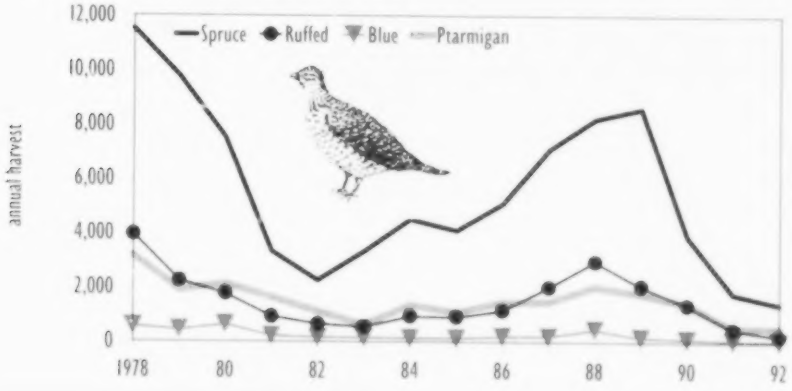
First Nations people near the Alaska Highway came into contact with illnesses for which they had no immunities: measles, dysentery, jaundice, tonsillitis and meningitis.

It's not like that, people never had no cancer; nothing, not even TB, headache. Well this one here all that sickness come through by highway too. Nobody got no cancer before and pretty soon they eat those white man food.

— Margaret Johnson, Champagne Aishihik Elder

Figure 4.23
Annual harvest of grouse and ptarmigan

The only systematic monitoring of upland game birds is through harvest monitoring. These data show that the populations are stable but cyclic (harvest is considered an indicator of population size). Harvest levels also indicate the relative abundance of the main grouse and ptarmigan species. Smaller numbers of sharp-tailed grouse are also harvested.



Birds of Prey

Thirteen raptor and six owl species make the Yukon their home. All raptors have status under the Convention for International Trade in Endangered Species (CITES) and many are actively monitored (see Section 4.4). Owls have not been monitored as actively. Recent research confirms that populations of some forest-dwelling species (for example the great horned owl) are highly cyclic, while others (snowy owl and hawk-owl) seem to fluctuate erratically.

Upland Game Birds

Seven species of grouse, including three ptarmigan species, occur in the Yukon. Again, for most species, tracking of the harvest is the only systematic monitoring. There is some concern regarding the sharp-tailed grouse and the willow ptarmigan, which are currently monitored more closely in the field. As Figure 4.23 shows, available data indicate cyclic numbers follow a 10 year period which is related to the hare cycle. There is no evidence of long-term declining trend in the populations.

Contaminants in Wildlife

Studies by several government agencies have looked at contaminant levels in Yukon game animals. Yukon caribou obtained during annual hunts were analysed for contaminants.[4] Waterfowl and game birds from across Canada were sampled by the Canadian Wildlife Service.[5] Studies of country foods used by First Nations looked at a variety of animals, including big game animals, ground squirrels (gophers), beaver, porcupine, and grouse.[6]

Some findings from these studies are:

- There was no contamination of meat or animal organs from organochlorines (including pesticides, PCBs, dioxins and furans).
- Metals levels were all within natural, safe ranges in the meat of all birds and mammals sampled.
- Kidneys and livers of some moose, caribou and porcupines contained high levels of cadmium. Scientists suspect that the higher levels of cadmium in the organs of some animals are related to these animals' diets. Preliminary sampling confirms this – cadmium levels in willow and alder are extremely variable and seem to be related to natural variation in soils. The cadmium levels in animal organs increase with the animal's age and vary from location to location. Because cadmium in some animals exceeded recommended guidelines, consumption guidelines for caribou organs have been issued (Figure 4.24).
- Levels of PCBs and other related contaminants in Yukon and Western Arctic waterfowl and game birds were about 10 times lower than levels found in birds from the eastern arctic. This is

WORLD WAR II 1942

1942 The U.S. Army built the Tagish Road and completed the Alaska Highway tote road.

1943 The Territorial Game Ordinance was amended to allow for a two-mile wide no-shooting zone along the Alaska Highway. The Kluane Game Sanctuary was created, prohibiting or restricting hunting and trapping.

Game warden come tell them they can't shoot no more moose, they can't shoot any more game. Even fishing, we can't fish no more after 15 September. We just don't know what happened. Everything change.
— Moose Jackson, Champagne Aishihik Elder

likely because most of these birds are migratory species and the eastern arctic birds overwinter in the Great Lakes area or further south – areas with known extensive use of these chemicals.

Cooperative Management Actions

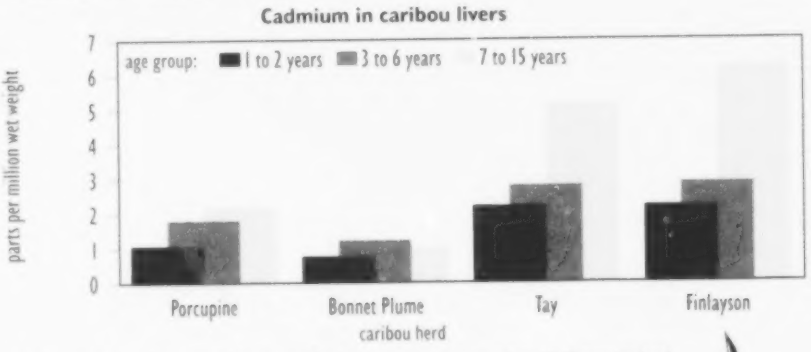
Cooperative management (comanagement) is the collaboration of government, First Nations and others in managing wildlife for the benefit of all users. In the past decade, communication between the government and First Nations has been improving. With the enactment of land claims legislation in February 1995, cooperative management will continue with local Renewable Resources Councils, the Fish and Wildlife Management Board and the four First Nations that have reached final agreements. A number of First Nations are already working with governments to carry out conservation actions. Here are a few examples:

- **Finlayson Caribou Recovery:** Hunters from five First Nations have voluntarily reduced their caribou harvest.
- **Aishihik and Kluane Caribou Recovery:** Hunters from the two First Nations in this region have persuaded government to begin a recovery program. Elders have contributed knowledge and made recommendations.
- **Southern Lakes Caribou Recovery:** Shared concern for the four Carcross subherds resulted in six First Nations and the Yukon and B.C. governments agreeing to stop hunting these caribou. A collaborative five-year recovery action plan is being implemented.
- **Mayo Regional Wildlife Management Plan:** In 1993, a three year management plan was developed by the Mayo Renewable Resources Council, the Nacho Nyak Dun First Nation, local outfitters and Renewable Resources.

Figure 4.24

Cadmium in Yukon caribou: levels of cadmium and advice to consumers

Cadmium, a metal the caribou pick up in their food from natural sources, isstored in the liver and kidneys. Caribou meat was tested and all samples were extremely low in cadmium. The older the animal, the more cadmium it will have built up in its liver and kidneys. The bars represent average levels of cadmium in livers of caribou of different age groups from four Yukon herds. Samples were taken from animals killed as part of subsistence hunting, 1988-1993.



Note: sample sizes vary greatly, from one (Tay herd youngest age group) to 69 (Porcupine herd middle age group). For the Finlayson herd youngest age group, the average is for 5 of the 6 animals sampled - an outlying sample with over 10 times higher cadmium is not shown.

Guidelines for consumers of Finlayson caribou, issued in 1993
(Based on WHO recommended maximum intake of 450 micrograms cadmium per week.)

- You can eat as much caribou meat as you want.
- You can safely eat these amounts of liver AND kidney in a year

Age of caribou	livers	kidneys
1 to 2 years	3	14
3 to 6 years	2 1/2	4
7 to 15 years	1 1/4	2

1943 WORLD WAR II

Got Big Lips On

They said the bulldozer coming pretty close now. All people go down to that old store, Champagne. All the people say the bulldozer coming pushing the road. Well, people bunch up there. All come down there they going to see that bulldozer coming. "Watch that big tree up there," they say. "Big tree standing, just over the hill there. Just the top showing. Watch that big tree up there — it's going to happen." Well, people watch that big tree. Pretty soon you see that top of that tree start shaking and down he go, that tree. Coming over that hill there was something. Some kind of animal. Well, that was the bulldozer. Got big lips on. Nobody see that kind before.

— Moose Jackson, Champagne Aishihik Elder

4.4 Endangered, Threatened and Vulnerable Species

To manage species at risk, government looks to the processes established by two national organizations: the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) which provides major scientific status assessment; and, Recovery of Nationally Endangered Wildlife (RENEW) which provides a framework for recovery efforts. The Convention on International Trade in Endangered Species (CITES) also assesses species at risk in an international forum and provides, on a few occasions, the impetus for management actions in the Yukon. Some species are identified as being at risk only in the Yukon because of local overharvesting or past management practices that affect the species.

In Canada, 256 plant and animal species, or recognizable populations, have been identified by COSEWIC as being at some risk. Of these, 128 are within the endangered, threatened or extirpated categories which, by RENEW standards, require immediate management actions.

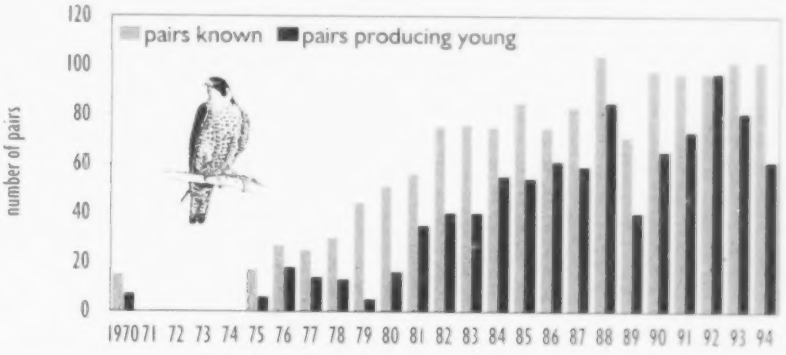
In the Yukon, there are three 'endangered' or 'threatened' (COSEWIC) animal species: the anatum peregrine falcon, the bowhead whale and the wood bison. Seven Yukon animal species are categorized as 'vulnerable', which implies that, although their populations are currently secure, they may be at risk in the near future.

In the Yukon, these 'vulnerable' species are also of concern to CITES. All birds of prey and four additional mammals (black bear, lynx, river otter and wolf) are considered secure in the Yukon but are the subject of international concern by CITES. There are no Yukon plants listed at risk either nationally or internationally.

COSEWIC categorizes species according to degree of risk, and the resulting amount of action required to recover or maintain their populations. Of these listed animals; no extirpated species are indigenous to the Yukon, but three demand immediate action and eight require close monitoring. In addition, five species listed by CITES are endangered on an international scale, but are currently secure within the Yukon.

Figure 4.25
Anatum peregrine falcons in the Yukon

As a result of environmental contamination, the anatum peregrine falcon population declined severely in the 1960s and 70s. From 1971 through 1974 there were no anatum peregrine falcons spotted during surveys in the Yukon. A national recovery plan and reductions in emissions of DDT have resulted in steadily increasing numbers of these falcons breeding in the Yukon.



Status of Species at Risk

Endangered Species: (COSEWIC)

Anatum Peregrine Falcon

STATUS: In the mid 1970s the species declined drastically until only a few remained in the Yukon. It was the subject of intensive management action for over a decade, and in the early 1980s the Yukon's anatum peregrines exhibited the first documented recovery in North America. Since then, the species has steadily recovered (Figure 4.25); the

Southwest Yukon game was depleted because of the accessibility provided by the Alaska Highway and the Haines Road.

Yukon Archives/Carter Coll.

number of confirmed breeders is now well above what was known initially.

RISK: It is thought that environmental contaminants absorbed by the anatum peregrine falcon's prey became concentrated in the birds and their eggs, resulting in reproductive collapse. The most serious contaminants (DDT-related pesticides) are now banned in Canada and the United States, but residues remain in the environment. Some of these chemicals are still in use on falcon wintering grounds in Mexico and Central and South America.

ACTION: The species is the subject of a national recovery plan in which the Yukon is a partner. An intensive survey every five years is supplemented with an annual survey of accessible sample groups.

Bowhead Whale

STATUS: The species declined drastically in the western Arctic in the late 1800s. Recently, due to intensive protection, it has been exhibiting an apparent recovery. The Beaufort Sea bowhead population is now the largest population of bowheads in existence. In recent years, the Inuvialuit have been permitted to harvest a single animal for subsistence purposes.

RISK: The species' demise was mostly due to overharvest and its recovery is likely due to intensive protection.

ACTION: The species is being monitored by Fisheries and Oceans Canada.

Threatened Species: (COSEWIC)

Wood Bison:

STATUS: The wood bison became extinct in the Yukon, not as a result of overharvesting, as was the case with the plains bison, but likely due to habitat change resulting from natural causes. The Yukon is part of a national recovery plan to establish independent breeding populations of wood bison in acceptable habitats. In 1986, 34 individuals were introduced to the Nisling valley in central Yukon. The wood bison have reproduced successfully and the population will likely reach the goal of 200 animals in the 1995-96 season (Figure 4.26).

RISK: The primary risk factor for wood bison is disease. Southern populations have been seriously reduced by tuberculosis, brucellosis, and anthrax.

ACTION: The population size is monitored annually with radio collars and aerial surveys. The productivity of the herd is monitored, along with habitat utilization. Part of the herd was moved back into captivity due to public safety concerns along the Alaska Highway.

Vulnerable Species (COSEWIC AND CITES)

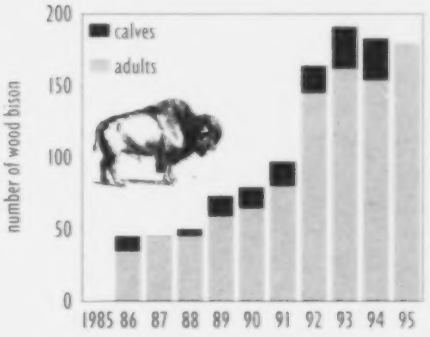
Of the 14 species listed in this category, most receive specific attention. At present, all are thought secure in the Yukon but merit monitoring.

Great Grey Owl: Status of the species is unknown. No standardized monitoring is in place; the species is considered naturally rare in the territory.

Figure 4.26
Re-introduction of wood bison to the Yukon

Before the introduction of 34 wood bison to the Nisling Valley, the species had disappeared in the Yukon. Despite the removal of 36 individuals in 1994, this re-introduction of animals, combined with the close monitoring of population and habitat, will allow the wood bison to reach the targeted population of 200 in 1995/96.

Note: 1995 calf count not available



Welder on the Canol Pipeline.
Yukon Archives/Finnie Coll.

Canol Road and pipeline were built as part of the project to pump oil from NWT to Whitehorse. The Canol Project used 15,900 personnel and 200,000 tons of materials.

The Haines Road was also completed, connecting Haines, Alaska with Alaska Highway at Haines Junction.

Grizzly Bear: The species is thought to be secure in the Yukon and is hunted annually. No systematic population monitoring, aside from tracking of the legal harvest, is carried out.

Polar Bear: Management under international agreement tracks, allocates harvest by permit, and guides ongoing research. Numbers are thought to be stable to increasing.

Short-eared Owl: Considered stable in the Yukon, but vulnerable due to long term population decline in the southern provinces.

Squanga Whitefish: The species is assumed stable. The vulnerability of the species is based on its very limited range and the threat of introducing competing, closely related species. No specific monitoring is carried out.

Trumpeter Swan:

Trumpeter swans, once widespread and abundant, number only about 16,000 worldwide. Like many waterfowl, trumpeter swans were decimated in the early 1900s by overhunting for food and plumage. In the past 100 years, this species has been recovering. Trumpeters have been increasing in numbers steadily and expanding their breeding range in Alaska, Yukon, Northwest Territories and northern B. C.

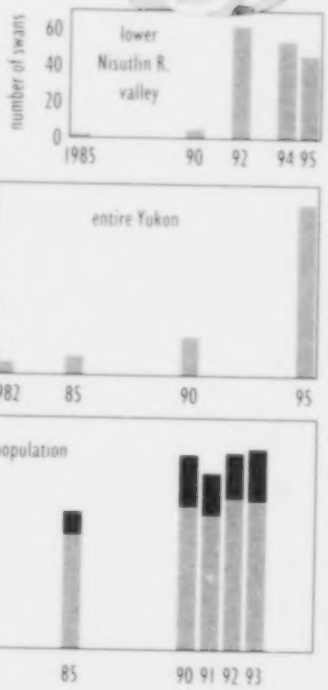
Two continental populations of trumpeter swans breed in the Yukon. Those breeding in the southeast corner of the Yukon winter in the American Midwest and the rest winter along the Pacific Coast. Numbers of trumpeter swans are increasing slowly and are thought to be at or above historic levels (Figure 4.27).

Trumpeter swans are monitored on the wintering grounds as well as within the Yukon. While the Yukon habitat is relatively undisturbed, increasing human population and conversion of habitat in the wintering grounds poses a threat to this species.

Figure 4.27
Trends in trumpeter swan populations

Results of summer surveys of nesting trumpeter swans show an increase, both for the entire Yukon and at one breeding area, the lower Nisutlin River valley in southeastern Yukon. The total population of trumpeter swans within the Pacific Flyway has increased since the 1960s.

Note: 1982, 85 and 90 surveys were of selected areas; the 1995 survey was a random sampling of the entire Yukon. Statistically speaking, the 1995 trumpeter estimate is: 1260 swans in the entire Yukon, plus or minus 517, correct 19 times out of 20.



Tundra Peregrine Falcon:

This subspecies disappeared as a breeder in the Yukon in the early 1980s (Figure 4.28). Together, Yukon and Alaska carried out population surveys and began monitoring the birds on the Yukon North Slope. Currently, the tundra peregrine falcon numbers are less than 20 per cent of historic counts, but are increasing slowly. Most recently, breeders have been re-establishing and three pairs have been identified in the Yukon. A

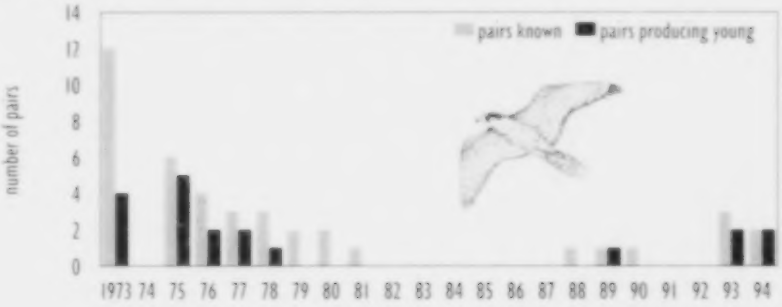
Abandoned construction camp
Yukon Archives/Harrington Coll.

slow but steady increase in tundra peregrine falcon numbers in the eastern Arctic has allowed it to be downlisted in Canada from threatened to vulnerable. Since populations in the Yukon clearly remain significantly low, the tundra peregrine falcon must be monitored closely.

Wolverine: The species is thought to be secure in the Yukon and is harvested annually by licensed trappers and a small number of hunters. No systematic population monitoring is carried out other than tracking the annual harvest.

Figure 4.28
Tundra peregrine falcons in the Yukon

Tundra peregrine falcon habitat in the Yukon is on the North Slope. No tundra peregrine pairs were spotted in surveys from 1982 through 1987.



Other Species of International Concern (CITES)

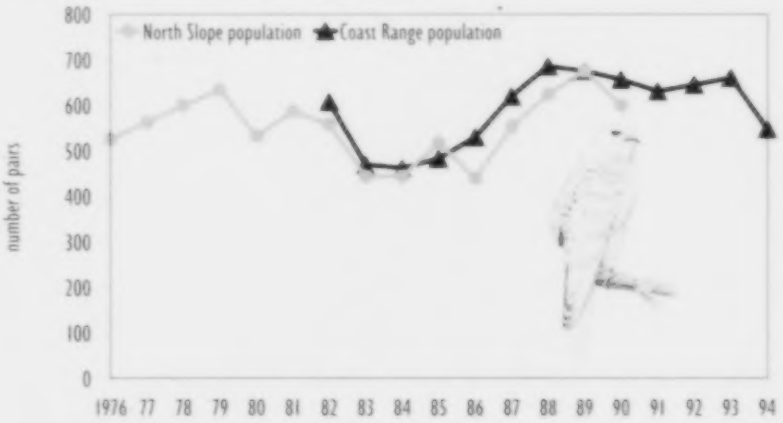
Gyrfalcon: Numbers of gyrfalcons in the Yukon are stable (Figure 4.29). The number of young reaching breeding age is reduced at low points of the cycle. Because this makes the species vulnerable, annual monitoring of sample populations is carried out.

Black Bear: The species is assumed stable in the Yukon and is hunted annually. The vulnerability of the species is based on a known high poaching loss in other jurisdictions which rarely occurs in the Yukon. The species is not monitored outside of the tracking of legal harvest.

Lynx: The species is assumed stable, but it has been well established that cyclic cat species such as the lynx are vulnerable to overharvest. Lynx numbers in the

Figure 4.29
Gyrfalcons in the Yukon

Gyrfalcon populations in the Yukon are stable but cyclic. This graph shows monitoring results from two sample populations.



1944 A 3500-barrel-per-day refinery opened at Whitehorse. It closed after less than one year.

1946 The Whitehorse refinery was dismantled, but the tar pit was left. The pit was used for waste oil disposal and as a source of oil for dust suppression on roads during the next decade. The tar pit remains today.

Whitehorse Refinery
Yukon Archives/Finnie Coll.

Yukon are not monitored aside from tracking the harvest. An ongoing long-term research project indicates that a refugium, a suitable habitat for reproduction, is necessary during population lows.

River Otter: The Yukon is on the northern edge of this species' range. It is assumed to be stable, though relatively rare. The river otter is harvested annually by licensed trappers, but this harvest is tracked.

Wolf: The species is known to be stable over most of the territory. Population monitoring is carried out regularly in selected areas mostly in conjunction with ungulate management, and annual harvest is tracked. A wolf reduction program is underway in the Aishihik region of the Yukon as part of a caribou recovery program (see Section 4.3).

Amphibians: Status is unknown. Continent-wide concern for the status of these species has raised awareness in the north. Four species of amphibians are known to occur in the Yukon: the boreal toad, northern wood frog, spotted frog and chorus frog. The northern wood frog is widely distributed throughout the Yukon, whereas the other three species are at the northern edge of their ranges and are only found in parts of the southern Yukon. Monitoring is being conducted mostly by volunteers who are part of a working group on declining amphibian populations in Canada.

In addition to animal species at risk, the Yukon contains rare and vulnerable habitats and land conditions. Some examples are: habitats for large predators such as the grizzly and the wolf; habitat areas for migratory herds of caribou; and unique northern wetlands and Beringia, the land that remained unglaciated in the last ice age, where unique plants and insects now thrive.

POST WAR 1947

1947 Alaska Highway opened to public.

1947 Sale of wild meat made illegal.

1948 Creation of MacArthur Game Sanctuary.

1949 Atlin Road connects B.C. with Yukon.

Chapter 5 Focus on Ecosystems

In most of this report living organisms are described in terms of populations and habitats. For many purposes this focus is adequate When discussing such matters as the overall health of the environment or sustainability, however, it is often necessary to consider the interactiions between different organisms together with their interactions with the environment in which they live. This entity, which includes many types of living organisms, the physical environment and the often complex interrelationships between them, is an *ecosystem*. In this section two important Yukon ecosystems are examined: wetlands and the boreal forest.

5.1 Wetlands

Wetlands are areas in which the water table is at or near the surface, such as bogs, fens, swamps, marshes and shallow lakes. Wetlands are storehouses and purifiers of water, and provide valuable wildlife and fish habitat. Many wetlands also contain large supplies of peat.

The Yukon is better known for its mountains than wetlands. We have approximately three per cent wetlands by area, much less than most other parts of Canada, but similar to British Columbia.[1] Wetlands are found along river floodplains and deltas and in the flatter, forested areas of central and southern Yukon. However, the Yukon's most extensive wetlands are north of the Arctic Circle on flat, poorly drained terrain with abundant peatlands and many shallow lakes.

Permafrost is widespread in the northern Yukon and wetlands are strongly influenced by freezing and melting cycles. Wedges of ice separate northern peat bogs into distinctive, polygon-shaped cells, forming geometric patterns over large areas. These peat bogs are often covered in lichens, making them of great value to caribou. When ground ice melts or when the water table is raised, the ground collapses and marshes and shallow lakes form in the depressions.

Throughout the Yukon, shallow lakes and marsh wetlands are especially important for waterfowl and other migratory birds, moose, muskrats, and beaver. Widespread species like lesser scaup, American wigeon, and mallard are among the most common waterfowl found here. We also have less common species such as trumpeter swans and Barrow's goldeneyes, whose breeding ranges are restricted to northwestern North America. There has been no systematic inventory of Yukon wetlands, but 48 wetland areas have been identified as significant, based on their value as migratory bird habitats.[2] Some are important breeding or moulting areas, while others serve as vital stopping places during spring or fall migration (Table 5a and Figure 5.1).

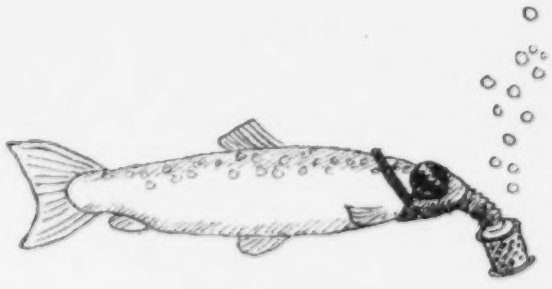
Peatlands and Climate

Many wetlands in the Yukon are peatlands, where 10 per cent or more of the plant material grown each year fails to decompose, instead becoming part of the substrate. These layers of dead material form the 'peat' over hundreds and thousands of years. This peat is an enormous storehouse of carbon and in many parts of the world is an important source of fuel. One potential effect of climate warming is an increase in the rate of decomposition of this peat. The decomposing peat releases methane and carbon dioxide, both greenhouse gases which contribute to global warming, further accelerating global climate change.

1949 POST WAR

DDT not A OK

1949 - 1969 Annual aerial spraying of DDT for mosquito control around Yukon communities, especially Whitehorse and the town of Watson Lake. DDT remains elevated in fish in the 1990s in Lake Laberge and Watson Lake.



Status of Wetlands

In many parts of Canada there has been substantial loss of wetlands and wetland values as a result of human activity. The main causes of this loss have been the draining of wetlands for agriculture or for urban expansion, and hydroelectric development. Major losses have occurred in the Prairies, southern Ontario, the Maritimes, and the Fraser River Delta.

In the Yukon, there has been little loss of important wetlands. Some grazing by horses has occurred in at least five of the 48 important waterfowl areas, at least four have adjacent residential developments, and at least two have adjacent agriculture. Roads skirt or cross some wetlands and may affect their function. None of these activities has had obvious and lasting detrimental effects on the wetlands.

The greatest human impact on wetlands in the Yukon has been from hydroelectric development. Two of the Yukon's three hydroelectric developments, Mayo and Aishihik, use the storage capacity of existing lakes as reservoirs and do not require the flooding of large areas by dams. The third development, Whitehorse Rapids, uses existing lakes and an impoundment. However, there have been environmental effects on wetlands. The hydro dam at Whitehorse and the control dam downstream from Marsh Lake have significantly altered the high water regime upstream on Marsh, Tagish and Bennett Lakes. The most noticeable change is that wetlands on those lakes, notably McClintock Bay, Lewes Marsh, Tagish Narrows and Nares Lake, have extremely high water in the fall until after freeze-up, rather than a decline after a mid or late-summer peak. This has probably reduced the value of these wetlands for waterfowl during fall migration.

The drastic decline in water level between freeze-up and spring has also had detrimental effects on muskrats. John Joe, who lived most of his life in the McClintock Bay area, provided this assessment of impacts during an interview in the 1980s: *I used to get three hundred rats sometimes along the river here [between McClintock Bay and the Yukon River control dam about 15 kilometres downstream]. In summer when the water is low, the muskrat are digging tunnels for winter. From there they can feed along the river bottom in wintertime. Now they build a dam and keep the water high, clean out a big bunch of willow along the bank and the muskrat are all gone. They can make little houses along the top of the ice, but they can't stay there all winter. They get cleaned out.*[1]

The Aishihik Dam has also affected the hydrology of wetlands, notably those at the mouths of tributary streams joining Aishihik Lake and upstream along the Sekulmun (Tagah) River to Sekulmun Lake. Again, the annual timing of lowest water levels has been little-changed, but the period of highest water has been shifted from midsummer to late fall. In addition, the control structures and current water licence allow a long-term lowering of Aishihik Lake levels below their historic natural range. The shallow wetlands, which are especially important for waterfowl and muskrats, are the areas most directly affected. These wetlands may be drawn down to very shallow levels or even completely drained. Government and the Yukon Energy Corporation are carrying out studies on the wetland and aquatic ecosystems affected by the Aishihik dam. The aim is to improve understanding of these ecosystems so that the hydroelectric project can be operated without serious ecological effects.

For wildlife species that migrate, such as birds, Yukon wetlands have remained stable habitats virtually unaffected by human activities. For these species, breeding, migration and wintering habitats further south are much more vulnerable and in increasingly short supply. Northern wetlands host larger numbers of ducks in years of drought on the prairies[1] and play an increasingly important role for some species such as the northern pintail, which has experienced a serious long-term decline on the prairies but has stable populations in the north. Estimated numbers of ducks nesting annually on the Old Crow Flats are shown in Figure 5.2.

1949

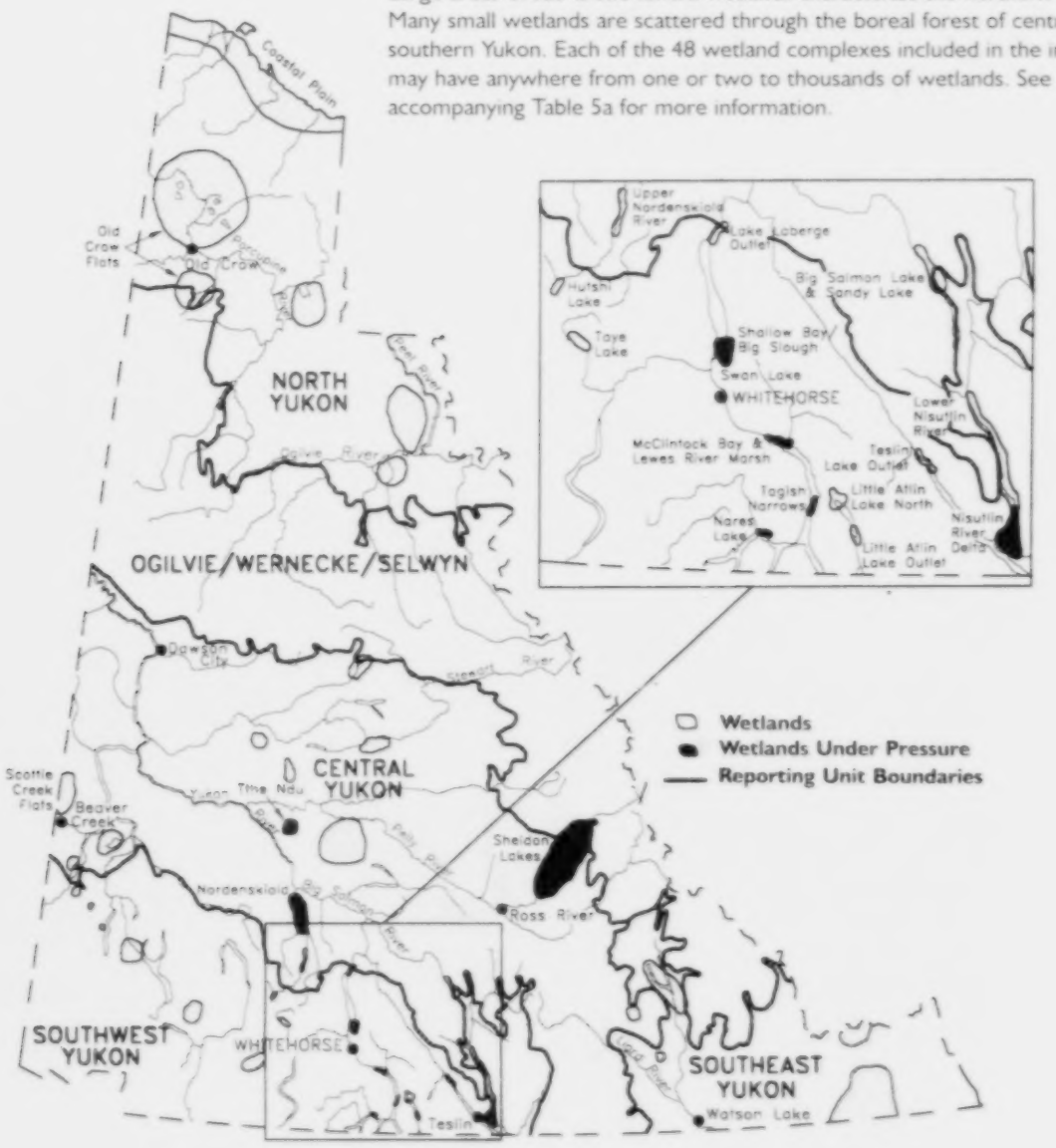
"I have to hunt for it"

They got chicken running around, they kill him. I feel bad about it, myself. I see white man do that. You want to eat chicken, you just cut his head off. I tell him, " I don't feel too good about it, right now. Me, I have to hunt for it." Him, " No! Just go out and cut his head off."

— Charlie Dick, Ross River Elder

Figure 5.1
Yukon wetlands inventory map

Large areas of sub-arctic tundra wetlands characterize the northern Yukon. Many small wetlands are scattered through the boreal forest of central and southern Yukon. Each of the 48 wetland complexes included in the inventory may have anywhere from one or two to thousands of wetlands. See accompanying Table 5a for more information.



1949 POST WAR

1949 Construction of Fish Lake dam altered the lake drainage that used to be through Jackson Creek and the Ibex River to the Takhini. It now drains via Franklin and Louise Lakes down McIntyre Creek to the Yukon River.

1950s Sediment sampled from Lake Laberge in 1992 indicated that a spill or release of PCBs occurred in or upstream of Lake Laberge at this time.

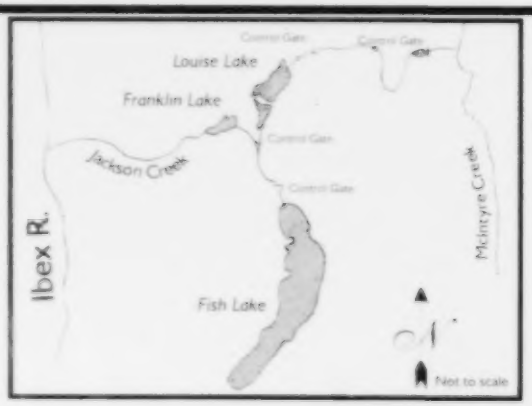


Table 5a

Yukon wetlands inventory: wetland areas and wetlands under pressure

Arrows (➡) mark wetland complexes identified as under pressure (potentially affected by human activity). Note that wetland areas have been measured in two ways: by total area of land plus wetland, and by wetland area only. Wetlands are grouped by Reporting Unit (see Chapter 6). Figure 5.1 shows locations of wetlands. This inventory is under development by the Yukon Waterfowl Technical Committee and will be updated as more information becomes available.

North Yukon: **Coastal Plain** (land+wetland area: 7100 km²) including 4 marine wetlands (633 km²) plus **Old Crow Flats** (land+wetland area: 7818 km²) plus 3 additional wetland complexes (wetland area: 343 km²)

Ogilvie/Wernecke/Selwyn: mountainous terrain with no major wetlands

Central Yukon: 11 wetland complexes (wetland area: 276 km²) including:
➡**Tthe Ndu** and ➡**Sheldon Lakes** (pressure: grazing); and ➡**Nordenskiold River** (pressure: agriculture)
plus **Scottie Creek Flats** (land+wetland area: 198 km²)

Southwest Yukon: 3 wetland complexes (land+wetland area: 1209 km²) plus 19 wetland complexes (wetland area: 168 km²) including:

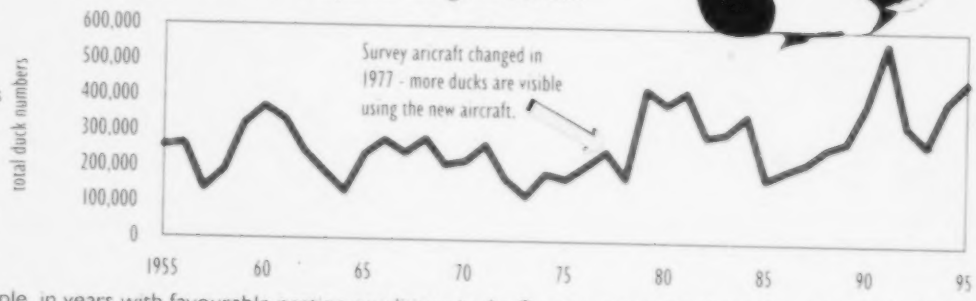
Wetland	*Pressures*
➡**Nisutlin R. Delta** and ➡**Swan Lake**	grazing
➡**Lewes R. Marsh**	hydro
➡**Nares Lake** and ➡**McClintock Bay**	residential and hydro
➡**Shallow Bay/Big Slough**	residential, hydro and agriculture
➡**Tagish Narrows**	residential, hydro and grazing

Southeast Yukon: 5 wetland complexes (wetland area: 59 km²)

Figure 5.2

Total duck numbers, Old Crow Flats, 1955 to 1995

These annual estimates of total numbers of ducks breeding on the Old Crow Flats are based on one-day aerial surveys along a transect. This is part of a larger waterfowl population breeding survey, which also includes 12 Alaskan wetlands. Fluctuations among years are related to the status of the population of each duck species on a flyway basis as well as to shifts in their distribution. For example, in years with favourable nesting conditions in the Prairies, numbers of some species of ducks are lower on the Flats. The peak in duck numbers in 1991 coincides with a Prairie drought year.



1949

You Never Make Fun of an Animal

We have respect for game. You don't talk about it or make fun of it, for they have spirits too. All animals have it. If you believe in the Great Spirit, that's the god of our ancestors, and you try to be observant of what they have done and that's passed down from one generation to another. You never make fun of an animal.

— Billy Blair, Beaver Creek Elder

Protection of Wetlands

Four of the 48 inventoried wetlands in the Yukon are protected through legislation (Table 5b). This includes the Yukon's two largest wetland areas, the Coastal Plain and the Old Crow Flats. Federal legislation related to land and water use provides mechanisms to minimize the effects of development on other Yukon wetlands. Activities on federal lands are subject to land use regulations and require a permit under the Territorial Lands Act. The exception to this is mining activities on lands covered by mining claims or leases. Projects affecting wetlands which involve the use of water also require licensing under the Yukon Waters Act. Terms can be set in the licence to protect wetlands.

5.2 Forests

Almost 60 per cent of the Yukon's land base is forested (275,000 square kilometres) and this represents about five per cent of Canada's total forested land (Figure 5.3). Three-quarters of Yukon forests are coniferous; the others are mostly mixed wood, composed of both coniferous and deciduous trees.

Forest lands are important for many reasons although most of the inventory work in the Yukon has been directed towards describing the economic value of the timber within the forest. For example, forest land is classified as 'productive' if the timber can be harvested economically.

Ten different tree species grow in the Yukon and all the forests that grow here are classified as boreal forest. These forests reflect three key environmental conditions: cool soil temperatures, low annual rainfall and a short growing season. The regions with the best potential for forest harvesting operations tend to be in the southeastern Yukon where trees have adequate growth rates.

The type of boreal forest in different areas of the Yukon depends on local conditions and weather. Changes in type may occur gradually along a gradient (Figure 5.4).

Table 5b
Yukon wetlands with protected status

Wetland	Protected as	Protection authority	Protected since
Coastal Plain	Special conservation regime east of Babbage River; Ivvavik National Park	Inuvialuit Final Agreement; National Parks Act	1984
Old Crow Flats	Special management area south of Old Crow River; Vuntut National Park	Vuntut Gwitchin Final Agreement; National Parks Act	1995
Nisutlin River Delta	National Wildlife Area	Teslin Tlingit Council Final Agreement; Canada Wildlife Act	1995
Horseshoe Slough	Habitat protection area	Nacho Nyak Dun Final Agreement	1995

Natural Processes in Yukon Forests

Succession

As forests age they change in several predictable ways. This process is called succession. For example, productivity (the rate at which new tissue is added) is greater in young stands than in older forests. Species composition may change as well. Pioneering

Local Products – Local Markets

Five to ten per cent of all lumber sold by three major Whitehorse retailers is supplied by Yukon mills. In the Keno and Elsa area, local wood timbers have been used to supply underground mines for years.

1950 THE FIFTIES

Trap It or Lose It

They look after their own game, they don't catch too much one place. And same with fur. This time you can't trap it where you want to trap. You got to trap within your trapline this time only cause one little circle you got there. You got to stay inside that circle. If game short there, you want to give your trapline a rest. Game Warden going to come to you "what you trapping on your trapline this year?" You said "not, getting too short there." From there he going to," if you don't use that trapline, you going to lose it". Well, we got to save our game.

— Moose Jackson, Champagne Aishihik Elder

species that are abundant early in succession (such as fireweed and aspen) are replaced in late succession by more shade-tolerant species such as mosses and white spruce. *Long time ago there were hardly any willows, like along the river you could see a lot of bare spots. But now it's all grown up. So I went down to my trapline that i left twenty years ago. There were old trees growing higher than this building, right along the trail, all the way through.* (Henry Broeren, Ta'an Kwach'an First Nation Elder).

Does succession ever end? Old growth white spruce forests often develop as a stable endpoint in the Yukon but even these forests are usually brought back to a pioneering stage by disturbances

Figure 5.3
Yukon forest lands

The total area of the Yukon is 48 million hectares. Slightly more than a quarter of the Yukon's forested land is considered 'productive', that is , biologically capable of producing economical timber harvests within a reasonable time period. White spruce makes up two thirds of the merchantable wood volume in 'productive' forests.

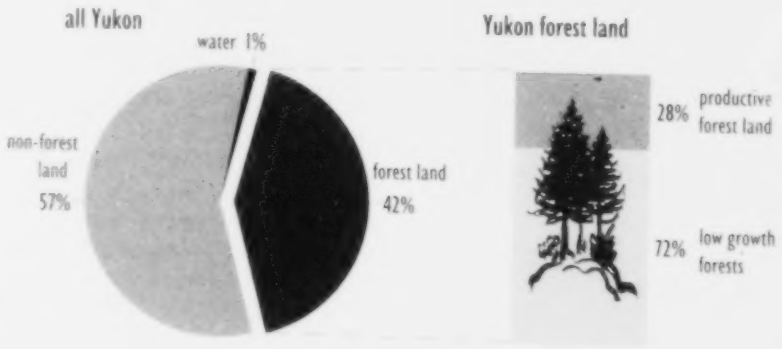
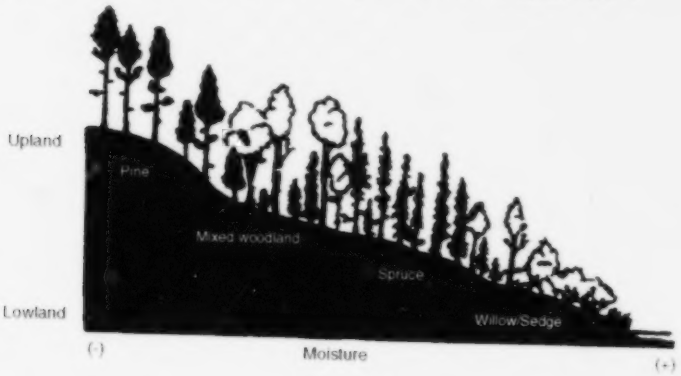


Figure 5.4
Vegetation gradient between a spruce and pine forest

White spruce trees generally grow best on fine-textured moist soils along creeks, rivers and lakes. As you walk up from the river, white spruce becomes scarcer and the soils become more coarse and well-drained. Lodgepole pine, a tree adapted to dry soil, becomes the dominant tree species on these upland sites.



Old-Growth Forest and Marten

Marten live in old growth forests. In parts of the southwest Yukon, marten were scarce in areas that had suitable old growth habitat but were surrounded by unforested areas or recent burns. Biologists believed the marten did not occupy the old forest habitat because they would not cross the open areas. Between 1984 and 1987, 171 marten were relocated to this area, with 88% of the marten surviving and establishing home ranges within the region.

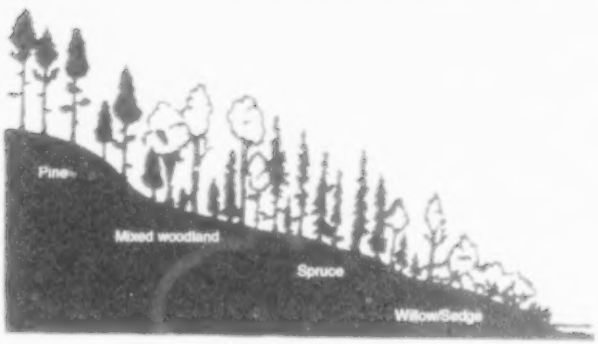
THE FIFTIES 1950

Trapline registration began.

Figure 5.3
Yukon forest lands

Figure 5.4
Vegetation gradient between a spruce and pine forest

White spruce trees generally grow best on fine-textured moist soils along creeks, rivers and lakes. As you walk up from the river, white spruce becomes scarcer and the soils become more coarse and well-drained. Lodgepole pine, a tree adapted to dry soil, becomes the dominant tree species on these upland sites.



1950

Forest Fires and Haute Cuisine

Morel mushrooms are one of the first species to grow in forests following a fire. The summer after a burn, long, root-like strands spread in networks through dead wood and soil, starting the process of decomposition and collecting water and nutrients to produce morels. Mushrooms and other fungi play an important role in cycling nutrients in the thin soils of boreal forests.

Although few local people harvest morels for their own use, these mushrooms are highly-prized in the international deluxe foods market. Mushroom picking in recent years has provided seasonal employment for some Yukoners as well as economic spinoffs from support for the industry.

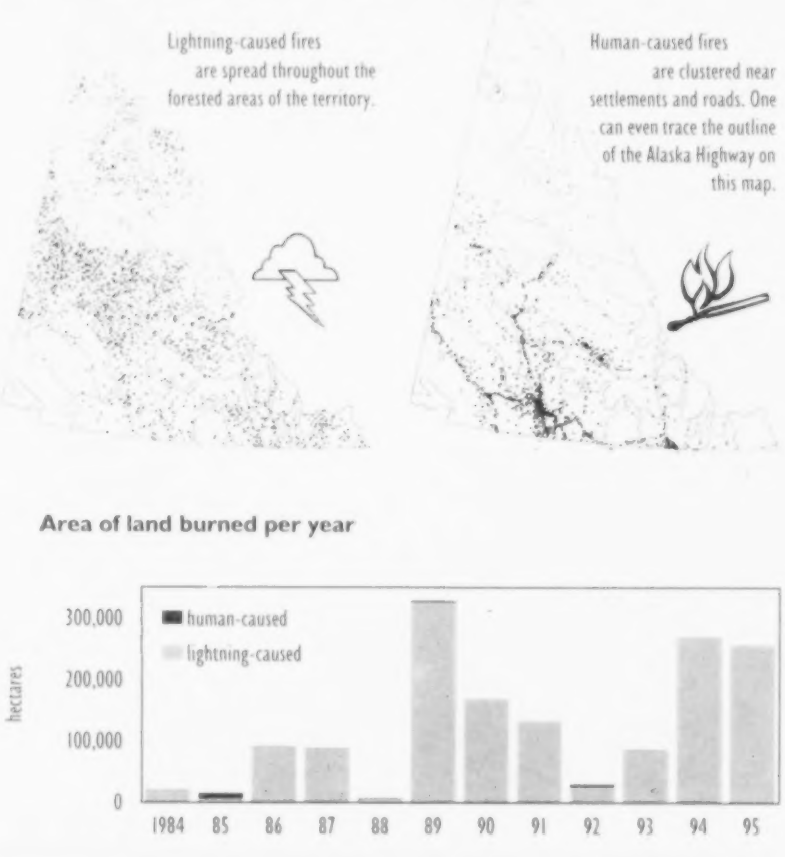
Morels are harvested from recent burns, dried in bush camps in the Dawson and Ross River areas, then shipped to restaurants and to brokers in British Columbia. Mushroom-picking is not regulated. Impacts of commercial-scale harvesting of mushrooms on Yukon forest ecosystems have not been examined.

such as fire, insect outbreaks or floods. Old growth forests are critical habitat for some plant and animal species in the Yukon. The golden-crowned kinglet, an insect-eating songbird, appears to be dependent on old growth white spruce forests.[1]

Fire

Plant communities in the boreal forest seem well adapted to periodic fire disturbances. Some species such as lodgepole pine seem reliant on fire episodes and may be replaced by white spruce if fires are infrequent. In the Yukon, the average timespan between

Figure 5.5
Ignition point and area of land burned by forest fires



1950 THE FIFTIES

The Silver Trail

All-weather road from Whitehorse to Mayo completed.

forest fires ranges from 80 to 200 years.[2] This means that, *on average*, a given area will burn once every 80 to 200 years.

The annual area burned in the Yukon can fluctuate widely between years. Although 40 per cent of the forest fires detected in the Yukon since 1984 have started due to human activity, Figure 5.5 shows that the area burned by human-caused fires is small in relation to the area burned by naturally-occurring fires. This is because many of the human-caused fires occur near settlements where they are quickly detected and extinguished. Figure 5.5 also shows the estimated starting point for all fires detected in the Yukon between 1946 and 1992.

Insects and Disease

Insects and disease-causing organisms play a vital role in the boreal forest – decomposing litter and serving as a food supply for birds and small mammals. Rigorous climatic conditions usually limit insect activity in the Yukon. However, active suppression of forest fires in the Yukon has increased the number of older, less vigorous trees; these forests are then more susceptible to attack when weather conditions favour insect populations.

The spruce beetle is one of the most common insects in Yukon forests. The first documented report of spruce beetle activity in the Yukon was in the late 1940s; approximately 39,000 hectares of spruce forest around Dezadeash Lake, in southwestern Yukon, was affected by the spruce beetle. There have been numerous spruce beetle outbreaks in Yukon forests since. The latest spruce beetle outbreak occurred in 1994, and covered an estimated 34,000 hectares of spruce forest in southwestern Yukon.

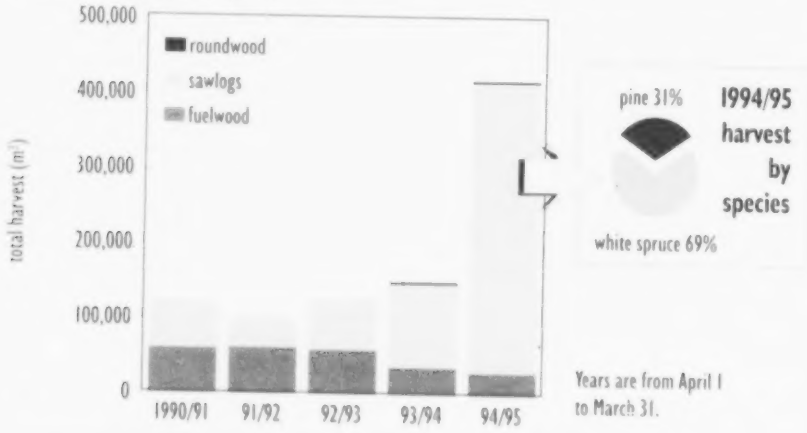
Human-Regulated Processes in Yukon Forests

Timber Harvesting

Until recently, Yukon logging trends have closely followed the economic activity level in the territory.[3] Major timber harvesting occurred during the Gold Rush. In 1900, an estimated 253,000 cubic metres of wood was cut for river steamers, mining and domestic purposes.[4] Recent demand for Yukon timber has been unprecedented and is caused by a variety of external factors. Figure 5.6 shows the annual volume of timber harvested in the Yukon, and Figure 5.7 shows the regional breakdown of this harvest. The Southeast Yukon reporting unit (Section 6.5) provides further detail on forest management.

Figure 5.6
Yukon timber harvest, 1990/91-1994/95

Total harvest has increased in the past year due to increased sawlog harvest in the Southeast Yukon. Roundwood, a small part of the harvest in all years, includes building logs, posts and railings. Over 99 per cent of trees harvested are white spruce or pine.



Silviculture

If timber harvesting operations are to be sustainable then trees must be replanted. This aspect of forest management is called silviculture. While timber harvests are not new to the Yukon, silviculture is. Until 1993 the Yukon relied on natural processes

End of the Sternwheeler Era

The construction of an all-weather road from Whitehorse to Dawson City spelled the end of commercial sternwheeler traffic on the Yukon River.

Yukon Archives/GSC Coll.

Figure 3.5
Breakdown of 1994-95 Yukon timber harvest by region

Figure 3.6
Five-year balance of Yukon forest land harvested and forest land planted

Prescribed Burns

1952

Nickel on Kluane Lake?

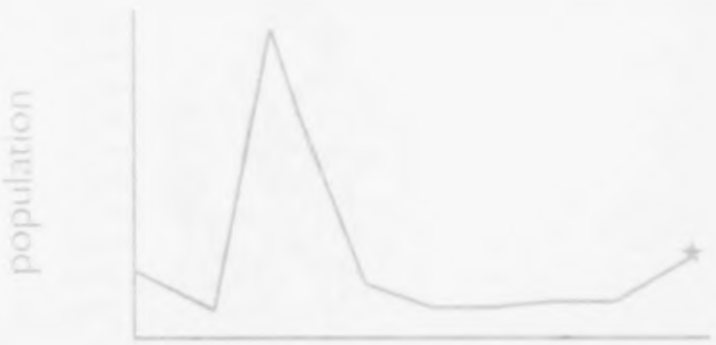
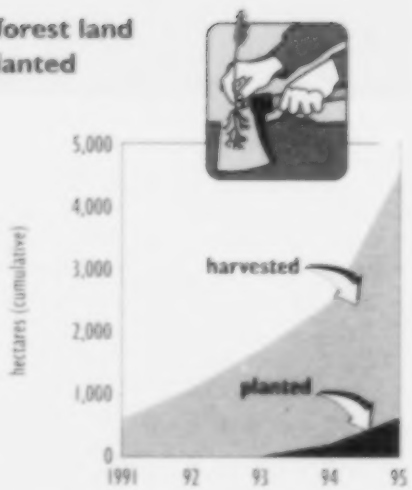


Figure 5.7
Breakdown of 1994/95 Yukon timber harvest by region

The 1994/95 total harvest includes sawlogs, fuelwood, building logs, posts and railings. The numbers next to each pie slice are the volumes of timber, in cubic metres, that was harvested on federal lands in each of the 8 Yukon forestry management regions.

Figure 5.8
Five-year balance of Yukon forest land harvested and forest land planted

Areas of forest land harvested and planted over the 5-year period ending March 31, 1995 are shown in this graph. Data are cumulative (each year's total is added to the previous years' totals.) Over the 5 years an estimated 4,571 hectares were harvested and 622 hectares (14 per cent of the area harvested) were replanted.



Note: area of land harvested is estimated from the volume harvested, using a conversion factor of 200 cubic metres per hectare. This conversion factor is considered to be a good average for the Southeast Yukon but may be high for the rest of the Yukon.

of reseeding to restore harvested areas. In the last few years several hundred thousand seedlings have been planted in southeastern Yukon (Figure 5.8). The hurdles facing this silviculture effort are formidable. Research to find the best silviculture approach for Yukon conditions is ongoing.[6]

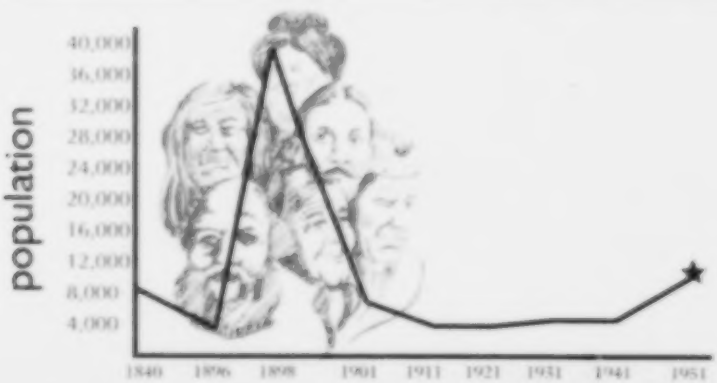
Prescribed Burns

There is evidence that firebreaks were maintained around some traditional villages by Yukon First Nations. Fire may also have been used to enhance wildlife habitat. Since 1985, Yukon resource managers have used fire as a tool to improve Dall sheep habitat. To increase winter forage, forested areas at Talbot Arm, on the north end of Kluane Lake, and Red Ridge, about 40 kilometres south of Whitehorse, were burned in 1985, and 1992/93 respectively.

1952 THE FIFTIES

Nickel on Kluane Lake!

Discovery of nickel deposit on Kluane Lake leads to 'mini-boom' of 1,247 registered claims.



Boreal Forests and Global Warming

Carbon dioxide is a key greenhouse gas and scientists believe it helps trap heat from the sun and contributes to global warming. Trees, like all green plants, help take carbon dioxide out of circulation in the atmosphere by splitting carbon dioxide molecules using sunlight. The oxygen is released to the atmosphere immediately, but plants retain the carbon and convert it into carbohydrates. The important point is that carbon can move freely between living organisms and the atmosphere. On the return journey carbon dioxide is released by forests through natural processes such as respiration, decay and wildfire. Researchers want to locate the major stores of carbon on a global scale and determine how quickly carbon dioxide levels are rising.

Canadian boreal forests (including peatlands) store an estimated 186 trillion kilograms of carbon within their biomass, soil and the forest products they produce.[1] If released, this carbon would contribute to the greenhouse effect. Currently, Canadian forests help reduce levels of carbon dioxide in the atmosphere by taking in more carbon each year than they release. This may change in the future for several reasons. The net amount of carbon that boreal forests take in each year may:

- *increase* if boreal forests expand north and take over unforested tundra;
- *decrease* because of disturbances that break down carbon stores, e.g. timber harvesting and increased rates of fire or insect outbreaks;[2]
- *decrease* simply because boreal forests are getting older. Young forests grow more quickly than mature forests. As the average age of boreal forests continues to increase, older forests will begin to release more carbon than they take in.

More Boreal Forest in the Yukon?

The changes in climate that have been predicted for northwestern Canada are expected to shift the boreal forest much further northward. It has been estimated that the northern boundary of the boreal forest may move several hundred kilometres north as a result of increased temperatures. Climate change could also affect plant communities by increasing insect infestations, the frequency of fires or fire intensity.[3]

Future Yukon Forest Management

The Yukon Territorial Government is currently negotiating the transfer of authority for forest management from the federal government. It is widely recognized that the existing legislation is inadequate and a new management approach is anticipated. The Yukon Conservation Strategy, adopted in 1991, for example, recommends comprehensive forest legislation that would address issues such as sustainability, conservation, and reforestation.

In 1995, the federal government imposed a moratorium on further commercial timber permits, pending development of improved forest management policy. This step was taken in response to forest management issues related to the significantly increased demand for Yukon timber resources, both locally and from British Columbia and Alberta operators. In early 1995, two forestry papers were developed. The Yukon Renewable Resources department prepared the "Framework for Yukon Government Involvement in Forestry". The Forest Resources section of the federal Department of Indian Affairs and Northern Development released a "Discussion Paper on Policy Changes to Stumpage Pricing, Reforestation and Forest Tenure in the Yukon". Following public review of the discussion paper,

DEW in the Cold War

The Distant Early Warning (DEW) Line was constructed between 1953 and 1955 along the Arctic coast, including stations near Komakuk Beach, Stokes Point and Shingle Point in the Yukon. Stations have been abandoned or transferred to the new North Warning System. Abandoned sites are being assessed for contamination. Arctic weather monitoring began with the DEW Line.

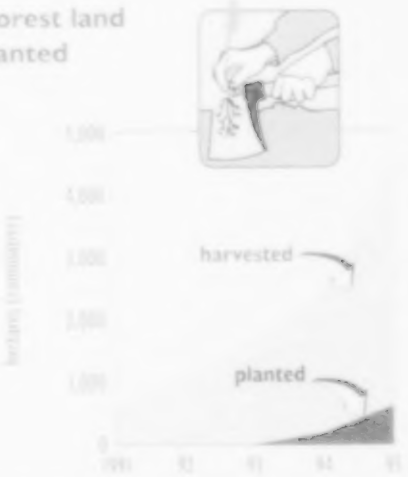
DEW Line station, Komakuk Beach
Canadian Parks Service

Figure 5.7
Breakdown of 1994/95 Yukon timber harvest by region

The 1994/95 total harvest includes sawlogs, fuelwood, building logs, posts and railings. The numbers next to each pie slice are the volumes of timber, in cubic metres, that was harvested on federal lands in each of the 8 Yukon forestry management regions.

Figure 5.8
Five-year balance of Yukon forest land harvested and forest land planted

Areas of forest land harvested and planted over the 5-year period ending March 31, 1995 are shown in this graph. Data are cumulative (each year's total is added to the previous years' totals.) Over the 5 years an estimated 4,571 hectares were harvested and 622 hectares (14 per cent of the area harvested) were replanted.

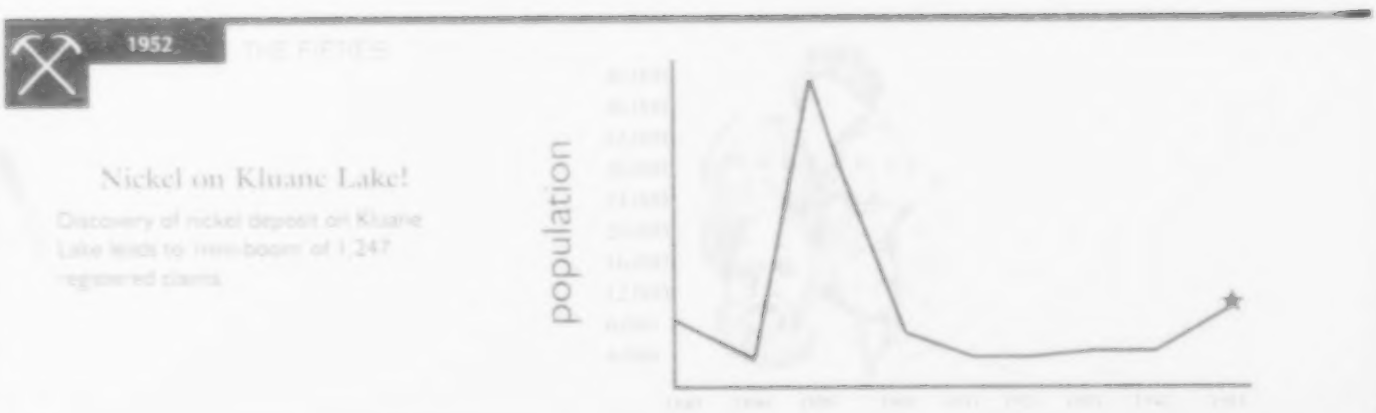


Note: 90% of land harvested is removed from the volume harvested, using a conversion factor of 200 cubic metres per hectare. This conversion factor is considered to be a good average for the lowland Yukon but may be high for the rest of the Yukon.

of reseeding to restore harvested areas. In the last few years several hundred thousand seedlings have been planted in southeastern Yukon (Figure 5.8). The hurdles facing this silviculture effort are formidable. Research to find the best silviculture approach for Yukon conditions is ongoing.

Prescribed Burns

There is evidence that firebreaks were maintained around some traditional villages by Yukon First Nations. Fire may also have been used to enhance wildlife habitat. Since 1985, Yukon resource managers have used fire as a tool to improve Dall sheep habitat. To increase winter forage, forested areas at Talbot Arm on the north end of Kluane Lake and Red Ridge, about 40 kilometres south of Whitehorse, were burned in 1985 and 1992/93 respectively.


1952
Nickel on Kluane Lake!
Discovery of nickel deposit on Kluane Lake leads to mini-boom of 1,247 registered claims.
population

Boreal Forests and Global Warming

Carbon dioxide is a key greenhouse gas and scientists believe it helps trap heat from the sun and contributes to global warming. Trees, like all green plants, help take carbon dioxide out of circulation in the atmosphere by splitting carbon dioxide molecules using sunlight. The oxygen is released to the atmosphere, and each leaf, plants retain the carbon and convert it into carbohydrates. The important point is that carbon can move freely between living organisms and the atmosphere. On the return journey carbon dioxide is released by forests through natural processes such as respiration, decay and wildfire. Researchers want to locate the major stores of carbon on a global scale and determine how quickly carbon dioxide levels are rising.

Canadian boreal forests, including peatlands, store an estimated 186 billion kilograms of carbon within their biomass, soil and the forest products they produce. If released, this carbon would contribute to the greenhouse effect. Currently, Canadian forests help reduce levels of carbon dioxide in the atmosphere by taking in more carbon each year than they release. This may change in the future for several reasons. The net amount of carbon that boreal forests take in each year may:

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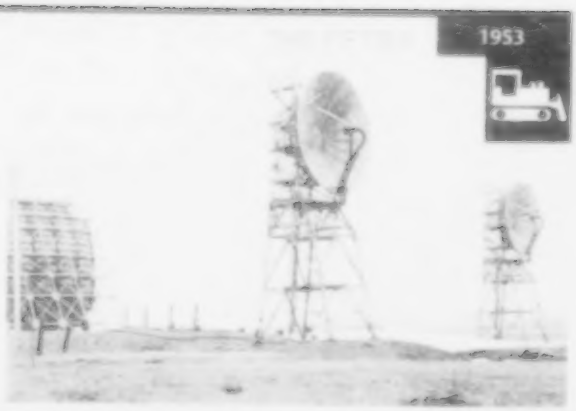
In 1998, the federal government imposed a moratorium on timber commercial timber permits pending the development of improved forest management policy. This step was taken in response to local outrage over issues related to the significant commercial demand for Yukon timber resources, both locally and from British Columbia and Alberta companies. In early 1999, two papers were developed. The Yukon Renewable Resources department prepared the "Framework for Yukon Government Involvement in Forestry". The Forest Resources section of the federal Department of Indian Affairs and Northern Development released a "Discussion Paper on Policy Changes to Strengthen Protection, Reforestation and Forest Industry in the Yukon". Following public review of the discussion papers

DEW in the Cold War

The Distant Early Warning (DEW) Line was constructed between 1953 and 1955 along the Arctic coast, including stations near Komakuk Beach, Stokes Point and Shingle Point in the Yukon. Stations have been abandoned or transferred to the new North Warning System. Abandoned sites are being assessed for contamination. Arctic weather monitoring began with the DEW Line.



DEW Line station, Komakuk Beach
Canadian Parks Service

Forest Resources intends to put into place a short-term management policy addressing the major issues of stumpage pricing, reforestation and forest tenure.

These actions will help guide forest harvesting in the short term, but a long-term approach to forest management is essential if this resource is to be sustainable and if the other values of the forest are to be protected.

Yukon Timber Rush

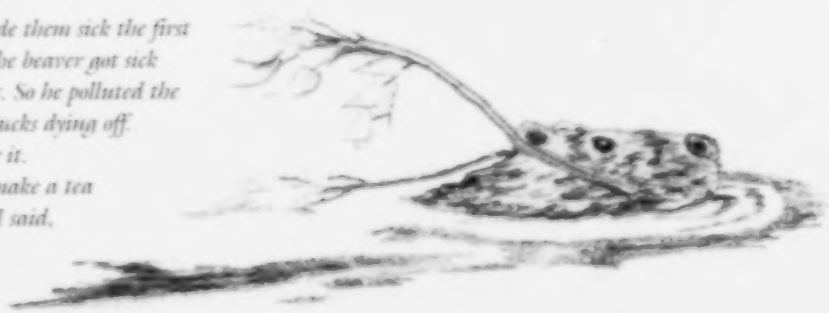
Timber exports from the territory have traditionally been limited by high transportation costs. Timber production was tied to local market demand and peaked during the goldrush and the building of the Alaska Highway. In 1994 the demand for Yukon timber suddenly increased due to:

- shortages of fibre in Western Canada, particularly British Columbia, where the annual allowable cut is being reduced to a sustainable level;
- high market demand (and prices) for forest products; and,
- sale of Yukon commerical timber permits below market value and with no requirement for replanting. These policies are currently under review.[3]

Beaver Fever

That story I hear, beaver fever. Who made them sick the first time? Somebody pollute the water and the beaver got sick and the beaver don't take the treatment. So he polluted the whole creek and the muskrats and the ducks dying off. Now I said, the beaver get the blame for it. Years ago you used to take a snow and make a tea with that snow water. Today you can't. I said, Who you blame for that?

— Bob Watson, Watson Lake Elder

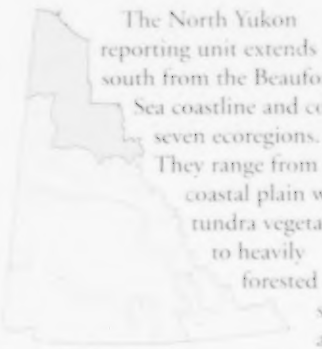


Chapter 6 Reporting Units

The Yukon is divided into five reporting units (Figure 6.1): North Yukon, Ogilvie/Selwyn/Wernecke, Central Yukon, Southwest Yukon and Southeast Yukon. Each reporting unit is a grouping of two or more ecoregions, based on the national ecological land classification system. Reporting on these areas allows for an integrated assessment of the various components of the environment.

Figure 6.1
Reporting units

6.1 North Yukon



The North Yukon reporting unit extends south from the Beaufort Sea coastline and covers seven ecoregions. They range from the coastal plain with tundra vegetation to heavily forested areas such as the Fort McPherson plain to areas with extensive wetlands such as Old Crow Flats (Figure 6.2). Prominent mountain ranges, the British and Richardson mountains, provide additional diversity.

Residents from communities in the Mackenzie River Delta maintain seasonal camps at several locations along the Yukon coast. However, the only permanent settlement in the region is the village of Old Crow (Figure 6.3). There is no road access to the community and subsistence is a way of life in Old Crow. The Vuntut Gwitchin emphasize the links between a healthy environment and the continuation of their lifestyle and culture based on traditional harvesting activities. The seasonal round in Old Crow finds people gathering food from a variety of sources: muskrats and waterfowl in the spring, salmon in summer and caribou in autumn.

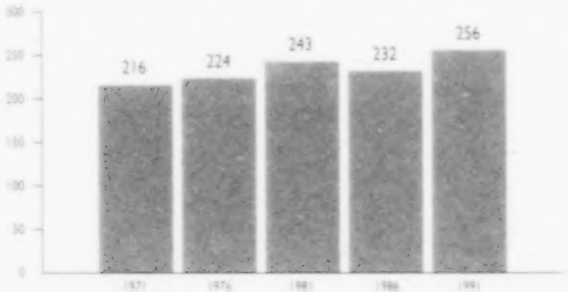
The Old Crow Flats represents one of the Yukon's most valuable wetlands and provides breeding habitat for several aquatic mammals, peregrine falcons and a variety of waterfowl. In summer, the Flats also serves as a waterfowl refuge for moulting (when birds become flightless) and staging for the fall migration. The Vuntut Gwitchin travelled throughout their traditional territory to hunt, fish and gather food. In spring, they journeyed to Crow Flats, a trip that is still made today.

It is the most beautiful country, is Crow Flats. A lot of people there, leave in the fall time by boat. Later on they get motor boats; they go up the Porcupine far as first stop at winter fur trapping place called David Lord Creek. That's twenty-five mile by trail. And further up is Salmon Cache; all those place, they have cabins. Further up is where Bell River comes in and on that Bell River is LaPierre House. Used to be our people play around there, long time ago and far back as you can remember. And further up is Johnson Creek, there is nobody there now. Those places used to be lots of people. Those people that did their fur trapping, they are all gone now and their children and grandchildren, they're all in Old Crow.

Effie Linklater, Vuntut Gwitchin First Nation Elder

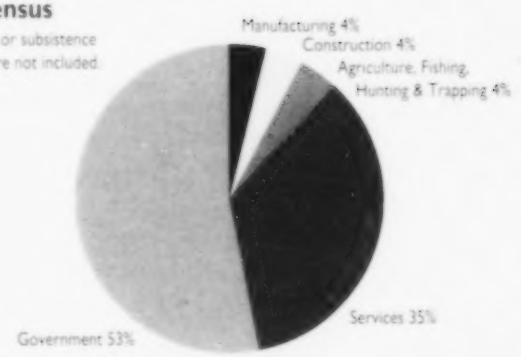
Figure 6.3
Population and employment - North Yukon

Population of reporting unit, 1971 - 1991



Employment by sector, 1991 census

* Non-wage or subsistence activities are not included.



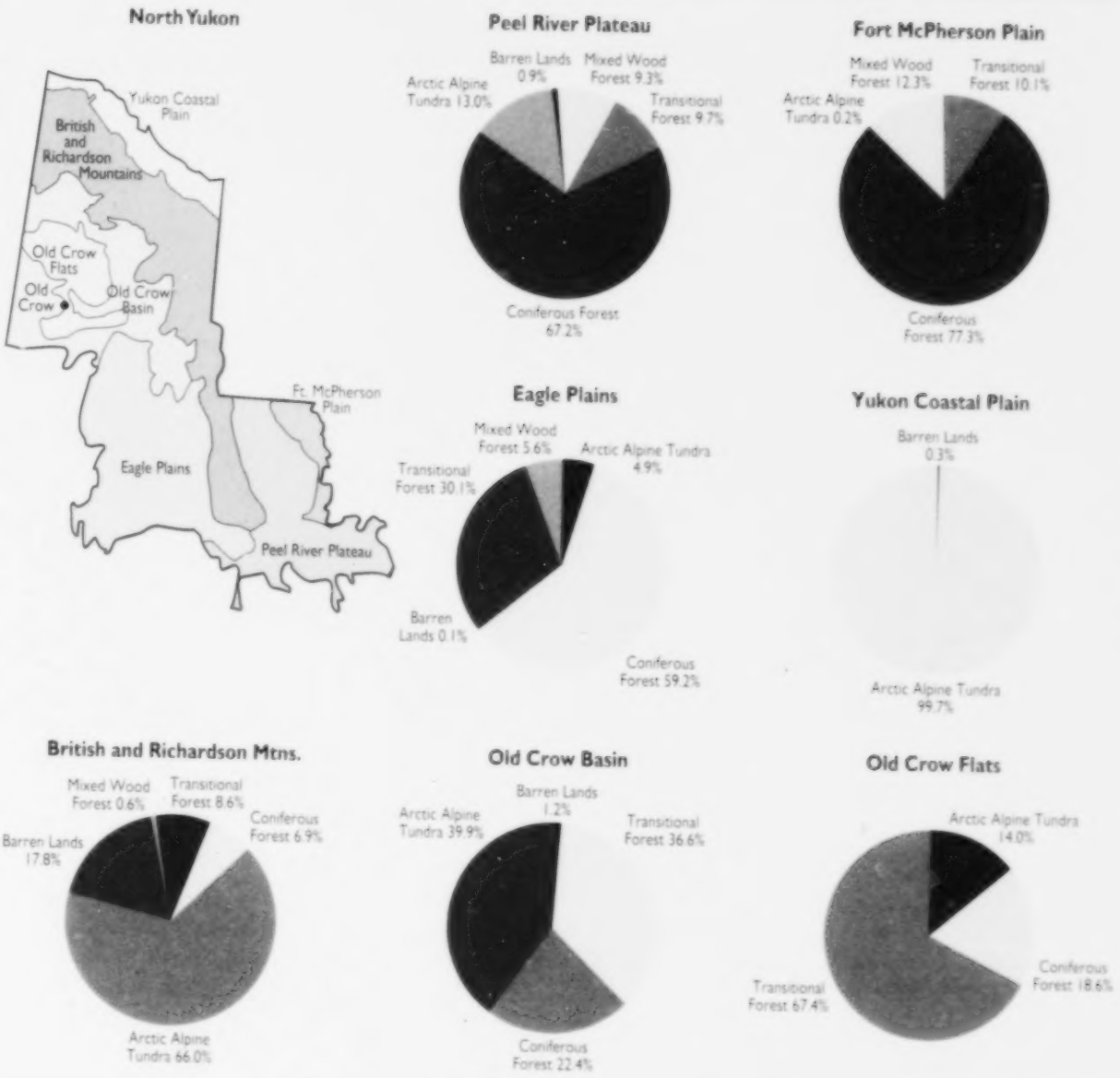
Community Populations December 1994

Old Crow	263

Employment by Sector, 1981 to 1991 Census

Sector	1981	1986	1991
Primary - (e.g. hunting/mining)	0	5	5
Secondary - (e.g. manufacturing of crafts)	0	0	5
Tertiary - (government/retail services)	65	65	105
Not Defined	15	10	0
Total	**80**	**75**	**120**

Figure 6.2
Land cover of ecoregions - North Yukon



THE FIFTIES 1954

Salmon Damn Dams

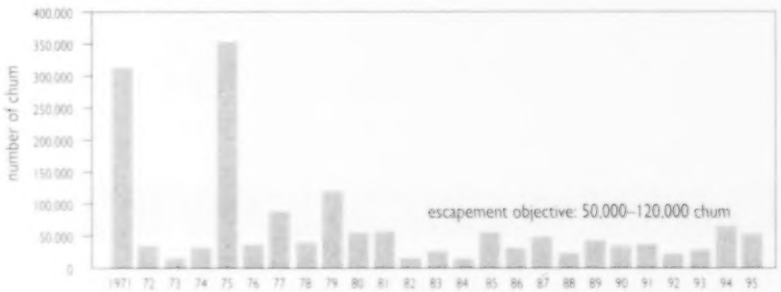
1954 Mayo Dam constructed to provide power for the silver-lead mine at Elsa. Salmon blocked from migrating upstream to Mayo Lake.

1957 Whitehorse Rapids Dam built, affecting the salmon run above dam. A fish ladder, the longest in Canada, was constructed the following year. During construction, salmon were captured and transported above the site in a tank truck. This was not successful.

Salmon have long been an important food source for the Vuntut Gwitchin. Three species, chinook, coho and chum travel up the Yukon and Porcupine rivers on their way to spawning areas on the Fishing Branch River and other Porcupine River tributaries. The Department of Fisheries and Oceans, in cooperation with the people of Old Crow, has set up a counting weir to monitor yearly salmon returns to the Fishing Branch River. Heavy harvests by Alaskan fishers have taken a toll and the numbers of returning chum are below the objective. (Figure 6.4).

Figure 6.4
Fishing Branch River chum salmon escapement

Chum salmon usually return from the ocean to spawn four years after they hatch. A high escapement return will usually be followed by another high return four years later. This four-year cycle is apparent in the data for the 1970s (note the peaks in 1971, 75 and 79). Many factors may affect this cycle, such as water level fluctuations, diseases, predation and, of course, fishing pressure. 'Escapement' means the number of spawning salmon that reach the spawning grounds each year.



Porcupine Caribou Herd

The Porcupine Caribou Herd, a large population of migrating Grant's caribou, has been an important part of the north Yukon's natural environment for thousands of years.

The year round range of this herd includes much of northeastern Alaska, the northern Yukon and the Richardson Mountains of the Northwest Territories. Calves are usually born in the Arctic National Wildlife Refuge along the Alaska coast of the Beaufort Sea. The herd generally spends its summer months above treeline in the Brooks Range and the British, Barn and Richardson Mountains. The herd may winter in the Peel and Porcupine river watersheds (hence its name) in the Yukon Territory as well as in northeastern Alaska. The range of the herd and the population size and estimated harvest levels are shown in Figure 6.5.

Gwitchin, Inuvialuit, Northern Tutchone and Inupiat from 13 communities in Alaska, Yukon and the Northwest Territories, rely on the Porcupine Caribou Herd for food. Non-native people from these villages and from larger communities such as Whitehorse and Fairbanks also hunt these caribou. The community of Old Crow has depended on the caribou for thousands of years and the Gwitchin people are dependent on the herd for the survival of their culture. The reported harvest of Porcupine Caribou has ranged from 2,000 to 7,000 per year over the past 15 years (Figure 6.5). The herd also supports predators such as wolves, grizzly bears and golden eagles.

Grant's caribou need large areas of relatively undisturbed tundra and boreal forest. These caribou are most sensitive to disturbance while on their calving grounds and less so while on their winter range. There is potential for oil and gas exploration and development in both these areas, but it is most likely to occur in the 1002 Lands within Alaska's Arctic National Wildlife Refuge.

Snow Depth and Calving Success

The depth of the snow on the Porcupine Caribou Herd winter range (along with several other climate components) has a direct effect on the number of calves the herd produces.

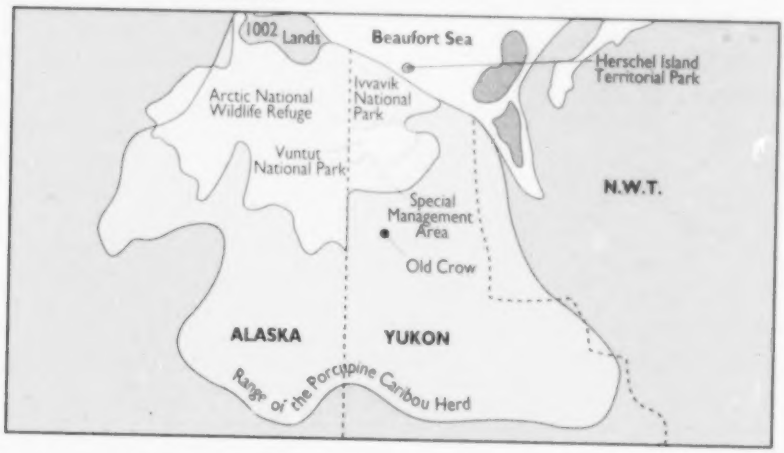
In the spring following a winter of deep snow, cows should still produce the usual number of calves, but because of the amount of fat the cows

Pipeline Links Yukon and Alaska

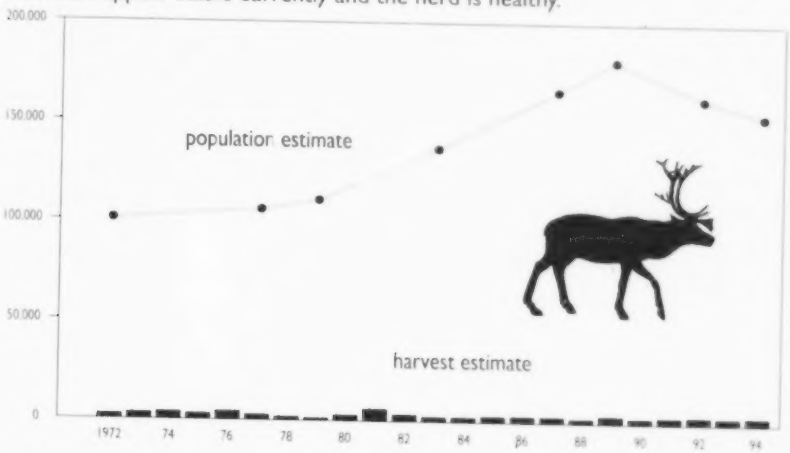
Haines-Fairbanks pipeline constructed. It operated until 1971 and was dismantled in 1991 leaving some contaminated soil.

Figure 6.5
Porcupine Caribou Herd: range, population and agreements

Porcupine Caribou Herd - Range of the Porcupine Caribou Herd lies squarely across the border between Canada and the U.S. Several parks and refuges have been established in this area.



Population - Porcupine caribou numbers have increased since the early 1970s. The herd almost doubled in size, reaching a peak of 178,000 in 1989. Between 1989 and 1990 poor weather conditions led to a decline in population size. Numbers appear stable currently and the herd is healthy.



Agreements - Negotiations to protect the Porcupine Caribou Herd involve many jurisdictions.

1970s	} Aboriginal claims involving range of herd
1980	U.S. legislation expands National Wildlife Refuge
1984	Inuvialuit Final Agreement created special management area
1985	Porcupine Caribou Management Agreement
1986	Ivvavik National Park
1987	International Conservation Agreement
1993	Vuntut National Park

will have used up digging craters in the deep snow to get food, (primarily lichens), they may produce weaker calves with a poorer chance of survival. The energy required to produce that spring's calves and nurse them through the summer (especially if it's a warm summer with a lot of insects), may also mean the cows will go into the fall breeding season in poor shape. Cows in poor condition may not come into estrus. Even if they are bred, and even if the following winter has normal snowfall, the cows may resorb their fetus within the first month or abort. The next spring, fewer calves are born.

Global warming, some scientists predict, may cause the northern Yukon to have greater snowfall in winter, faster melt period in spring and warmer summers. If this happens, the Porcupine Caribou Herd could shrink.

North Yukon Wildlife Management

There are three principal challenges to management in the northern Yukon. First, transboundary issues appear frequently. Many animals move back and forth across boundaries that are either international (Yukon/Alaska) or territorial (Yukon/Northwest Territories). The second challenge is one of coordination. What happens if wide ranging populations are harvested by different groups or communities? There must be some mechanism to ensure that the overall harvest is sustainable. Finally the health of many northern populations depends on certain key habitats at particular times of the year. These critical habitats must be identified and protected.

To an outsider, management in the northern Yukon must be bewildering! There are overlapping jurisdictions along with shared management between community groups and different levels of government. Let's look at the successes. The Inuvialuit Final Agreement was signed in 1984 and established a cooperative management process for the Inuvialuit Settlement Region that extends across

the northern Yukon (Figure 6.6). There is now considerable habitat protection. Ivvavik National Park and Herschel Island Territorial Park were created through settlement of the Inuvialuit (Western Arctic) land claim. As a result of the recent Vuntut Gwitchin land claim agreement, Vuntut National Park was created.

Figure 6.6
North Yukon jurisdictions

Coastal Marine Region

The coastal marine region of the northern Yukon supports a wide diversity of organisms. Productivity at this northern latitude is low and few of these organisms tend to reach high densities (except perhaps biting insects). Many of the animals found in southern Yukon also occur here, however several species are unique to this part of the Yukon.

Many species of birds and fish rely on the estuaries and coastal waters for food and shelter and for rearing grounds for their young. This makes them vulnerable to the effects of oil and gas development, including accidents such as oil spills. During the 1980s, a period of active oil exploration and development planning, the distribution and habitat use of many animals were documented. Studies on mammals, birds and fish and their use of habitat are now being conducted under the Inuvialuit Final Agreement. The goal is to conserve the diversity of habitat, fish and wildlife.

A total of 21 species of fish, including numerous species of whitefish, are found along the Yukon North Slope. Many of these fish spend part of the year in fresh water and part of the year in the Beaufort Sea.

A population of anadromous Dolly Varden charr use several of the large river systems along the Yukon coast. A commercial fishery targeting these charr was developed in the 1960s. After only two years of operation it was apparent that the population could not withstand commercial scale harvests and the fishery stopped. Northern fish such as charr take years to mature in cold, unproductive waters. They may feed for only three to four months of the year in the ocean and then overwinter in small stretches of rivers where underground springs prevent the water from freezing to the river bottom. Food in this habitat is limited, forcing them to fast until the next open water season. River habitats which do not freeze solid are in short supply and fish populations could be vulnerable to disturbances such as water withdrawals.

The Beaufort coast and sea provide habitat for thousands of ducks, geese, swans, shorebirds and marine birds from June through September. Use of habitat shifts with the seasons and with the annual cycle. Different areas are used for nesting, brood-rearing, moulting and as stops during migration. River deltas, spits, lagoons and islands are areas of particularly high use.[1]

Several marine mammals occur in the Beaufort Sea off the Yukon coast. The Inuvialuit have a strong cultural

tradition of harvesting several of these species. Ringed seals were once important in the local cash economy but the market for seal pelts disappeared and the current Yukon harvest is fewer than 10 per year. Whaling, however, continues to be a key subsistence activity during summer.

An estimated 21,283 beluga whales were visible during a 1992 aerial survey of the southeast Beaufort Sea, Mackenzie Estuary and west Amundsen Gulf. An unknown additional number of beluga would have been out of sight below the surface during the survey.[2] A small Yukon harvest of this population takes place each year (Figure 6.7).

Bowhead whales also range along the Yukon coast and these baleen whales often gather in groups in fall to feed. This population appears to be slowly recovering after an excessive commercial kill at the turn of the century. Inuvialuit from Aklavik and other communities gathered at Shingle Point and harvested one male bowhead whale in 1991.

Drift Waste Along the Coast

Four surveys of drift waste along the Yukon Beaufort Sea coast were undertaken from 1984 to 1990. Large items were counted during helicopter surveys (Figure 6.8). Foot surveys and beach clean ups on sections of beach in the 1989 and 1990 surveys showed that many more small items wash up on beaches than are visible from the air. Pieces of styrofoam were the main small items. True density of drift

Figure 6.7
Beluga harvest within Inuvialuit Settlement Region

The annual beluga harvest is an important part of the Inuvialuit subsistence lifestyle. The Beaufort Sea Beluga Management Plan was developed in 1993 by the Fisheries Joint Management Committee. The goals of the plan are:

1) to maintain a thriving population of beluga; and
2) to provide optimum sustainable harvest of beluga by Inuvialuit.

Total Beaufort Sea and area beluga population estimate: well over 21,000

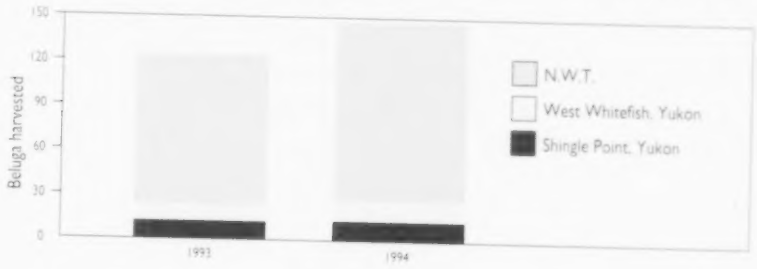


Figure 6.8
Beaufort Sea drift waste

Drift waste degrades the natural shoreline environment and can damage fish and marine wildlife which may swallow small items or become entangled in ropes and plastic sheeting.

Types of drift waste:

- styrofoam: floats, buoys, drill collars, insulation, packing materials, cups
- hard plastic: one-litre oil bottles, other containers
- rope
- tarps and plastic sheeting

Most likely sources:

- oil and gas exploration
- navigation
- hunting and fishing camps

THE SIXTIES

1958 Major fires threatened Teslin and Whitehorse.

1959 Oil discovered on Eagle Plains.

waste of all sizes estimated from these surveys averaged 1,079 items per kilometre of coastline in 1989. This is a higher density of drift waste than recorded in beach surveys on the Isle of Skye, the Ducie Atoll in the South Pacific and Amchitka Island, Alaska and similar to the density of drift waste found on a remote island in the South Atlantic.

Oil and Gas Activity

In the Canadian portion of the Beaufort Sea, exploration for offshore oil peaked in the 1980s. During the period of oil exploration, platforms and artificial islands were used to drill test holes under the sea. Herschel Basin, adjacent to Herschel Island Territorial Park, was an important storage and maintenance area for the oil industry. Fuel storage and transfer, and ship and drilling rig maintenance were carried out in this harbour. However, an assessment of Herschel Basin showed that sediments have not been contaminated from this activity.[1]

Discharges to the sea from drilling activity are regulated through the federal Arctic Waters Pollution Prevention Act, and disposal of materials at sea is regulated through the Canadian Environmental Protection Act. Permits of any nature that are issued in the Inuvialuit Settlement Region are screened through a process established by the Inuvialuit Final Agreement.

Because exploitation of the offshore oil involves transport to southern markets, either by pipeline or by tanker, the possibility of major oil spills in the Beaufort has been examined. Should a spill occur during the short open water season, some cleanup would be possible using conventional methods (because of the light type of oil and relatively calm seas). Some oil could be contained and recovered and the remainder would disperse, collect on the shoreline, evaporate or be burned off. During other seasons, the low temperatures, the long periods of darkness, the remoteness and the presence of ice would limit the effectiveness of spill cleanup.[2]

In the event of an oil spill, the polluter is immediately responsible for cleanup, although government takes charge of cleanup operations if the polluter does not have that capability. The Coast Guard maintains an inventory of spill response equipment in the Western Arctic (as the oil industry did when they were active in the area). The company or government agency directing a spill cleanup is advised on how to lessen environmental impacts by the Arctic Regional Environmental Emergency Team, a multi-agency standing committee chaired by Environment Canada. Information has been compiled on sensitivities of shoreline areas along the Beaufort Sea so that cleanup efforts can be directed towards preserving key coastal habitat.[3]

Military Activity

There are three sites of the former Distant Early Warning Line air defence network (DEW Line) along the Yukon Beaufort Sea coast. The DEW Line, operated by the United States Air Force from 1957 to 1993, has been replaced by the North Warning System (NWS), operated by the Department of National Defence as part of Canada's commitment to North American air defence. Shingle Point is the site of a NWS long range radar installation. Stokes Point, a former DEW Line intermediate site in Ivvavik National Park, has been abandoned since the 1960s.

Stokes Point has been cleaned up, and much of the abandoned material was moved to Shingle Point. The United States Air Force recently closed out the DEW Line facilities at Shingle Point and Komakuk, securing the facilities and removing obvious hazardous materials. These sites need further cleanup to be left in an environmentally safe condition.

Conditions at these sites have been assessed and the cleanup plan is almost complete. The cleanup will target debris, contaminated soil, landfills and excess infrastructure, based on the Department of National Defence's DEW Line cleanup protocol. In the meantime, the Government of Canada is negotiating with the United States to share the costs.

1965

Clean Up After Yourself Asbestos You Can

The asbestos mine opened at Clinton Creek. It closed in the mid 1970s leaving unstable tailings piles that have slumped into the creek.

6.2 Ogilvie/Wernecke/ Selwyn Mountains

The Ogilvie, Wernecke and Selwyn mountains form a broad mountainous band across the north central Yukon (Figure 6.9). Bedrock and colluvium characterize steep, rugged slopes at higher elevations.

Rounded valleys and scattered cirques throughout most of these highlands show that these mountains were glaciated. The northeast slopes of the highest peaks in the Selwyn Mountains, such as Keele Peak and the Itsi Range, are still glaciated. In contrast, the 'castellations', castle-like rock outcrops along ridge summits, and long scree slopes characterize the unglaciated Northern Ogilvies.

Permafrost is common and near surface permafrost occurs in fine textured sediments on lower slopes.

The Ogilvie-Wernecke-Selwyn mountains are a major barrier to the prevalent winds resulting in increased cold and precipitation on their southeast slopes. Due to winter inversions, temperatures at higher elevations are relatively moderate with the most severe winter temperatures encountered in the valley bottoms.

Alpine tundra dominates higher elevations. Open black spruce forests and woodlands are common on moist permafrost slopes and drier uplands. White spruce forests are usually limited to river valleys at lower elevations.

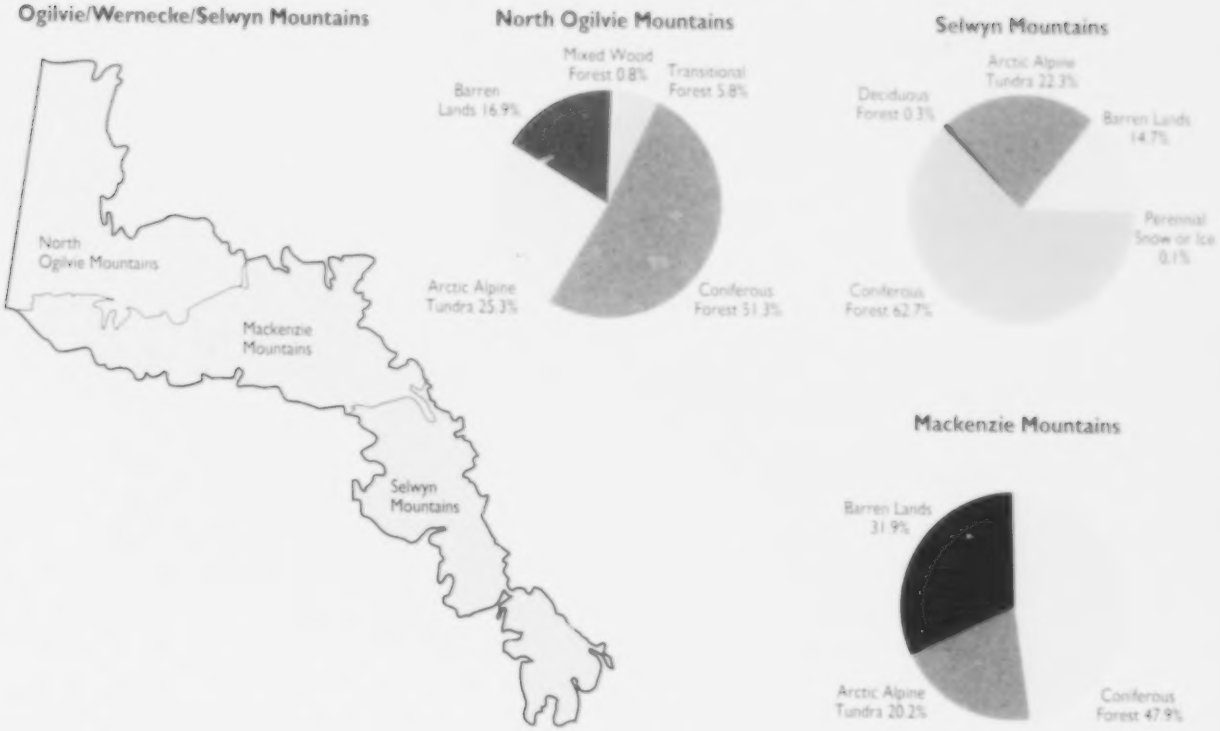
Numerous Yukon rivers have their headwaters in this area. The Ogilvie, Blackstone, Hart, Wind, Bonnet Plume and Snake rivers all flow north to the Peel River. The North Ogilvies drain north into the Porcupine River. The Klondike, Stewart, Hess, Ross and Macmillan flow west to the Pelly and Yukon rivers. In the southeast, the Hyland and Coal rivers are south-flowing tributaries of the Liard.

There are no permanent communities in this region. The population is extremely low with fewer than 56 persons living in the reporting unit. Most use is seasonal. The traditional territories of four First Nations: Tr'on dek Hwech'in, Vuntut Gwitchin, Nacho Nyak Dun and Ross River extend into this region.

Wilderness Tourism

The spectacular mountain landscape of the Ogilvie, Selwyn and Wernecke mountains offers the backcountry traveller wonderful opportunities for wilderness experience. The natural ecosystems, which range from boreal and subarctic forests to alpine tundra, are largely

Figure 6.9
Land cover of ecoregions - Ogilvie/Wernecke/Selwyn Mountains



undisturbed by people. The Bonnet Plume, the Wind, the Macmillan and Snake rivers offer unparalleled wilderness canoeing.

Ten registered hunting outfitters operate in different parts of the mountains in designated areas. In addition to big game hunting, many outfitters provide a range of wilderness opportunities for their clients including photo safaris and fishing. Several other companies lead river trips by canoe, kayak and raft, backpacking trips, fishing, photography, skiing and horse packing trips. While big game outfitting is regulated, wilderness guiding is not, except for some guidelines for commercial white water rafting.

Many wilderness seekers do not participate in organized tours. Aircraft can be chartered from most Yukon communities to fly in to lakes to start river trips, and for fishing, hiking, resident hunting and flightseeing.

Many visitors to the Yukon spend time in outdoor pursuits, but fewer spend time in remote wilderness. Difficult access and the physical and psychological discomfort of remote wilderness means that the wilderness tourism in the Ogilvie, Wernecke and Selwyn mountains appeals to a small but growing segment of outdoor enthusiasts. This group of adventurers is looking for quality tourism destinations. A recent advertising campaign by the Department of Tourism targeted this market segment.

Mining, Mineral Exploration and Wilderness

The relatively recent interest in remote Yukon areas for recreation contrasts with the longer term interests of mining in remote areas. Prospecting, mineral exploration and mining have been going on in the Ogilvie, Wernecke and Selwyn mountains since the early 1900s. The Wernecke Mountains in particular are scattered with small exploration targets. Only a few of the larger mines and exploration sites appear on the map (see Section 3.1).

The Wernecke's have been a principal region of exploration since the late 1960s. Exploration, primarily for uranium, copper, cobalt, lead, zinc and coal, peaked in the late 1970s and early 1980s. Renewed interest in the area since 1992 has been mainly associated with the Wernecke breccias which host copper, uranium, cobalt, silver and gold. Staking, geochemical sampling, geophysical surveys and drilling are the major activities. Winter roads north of Mayo provide access to many sites in the Wernecke Mountains. The Hart River area in the southern Ogilvies has potential for base metal deposits including the Hart River massive sulphide deposit. Exploration is also ongoing in the Macmillan Pass area of the Selwyn Mountains.

Though there is potential for mining development in these mountains there have been very few operating mines. The isolation and lack of transportation infrastructure are probably the greatest impediments to mining in this region.

Protected Areas

There is only one protected area in this reporting unit. The Vuntut Gwitchin land claim settlement created the Fishing Branch Ecological Reserve in the northern Ogilvie Mountains. A surrounding Habitat Protection Area is proposed which will be managed with the reserve as one ecological unit. The Bonnet Plume River has been nominated as a Heritage River. A management plan for the area is now being prepared and formal designation of this Heritage River is expected in 1996. The Tombstone Mountain area, of historical and traditional significance to First Nations, and a spectacular natural landmark, has been an area of interest for park designation for many years. It is expected to be protected as a Special Management Area under the provisions of the Tr'on Dek Hwech'in First Nation Land Claim. Other Yukon Park areas of interest are in the Selwyn Mountains.

The protected areas help preserve wilderness and the homelands of the First Nations for future generations. There is substantial economic value of these lands in wilderness tourism and traditional lifestyles.

Until recently there has been little conflict between mining interests and those advocating wilderness protection. The Canadian Parks and Wilderness Society (CPAWS) instigated litigation in

THE SIXTIES

1967-1971 New Imperial Mines started open pit mine near Whitehorse. Nearly three million tonnes of copper ore were extracted from four pits.

1968-69 New Venus Mill opened south of Carcross. Arsenic was later found in the tailings on the shores of Windy Arm.

1969 Campbell Highway constructed.

1969 Faro mine opened.

1995 over a land use permit to improve the winter road to the Fairchild Lake project in the Wernecke Mountains near the Bonnet Plume River.

The tension between development and wilderness preservation is likely to become an increasingly important issue.

The Dempster Highway

"...A meandering line through the heart of the true north..." the Dempster Highway provides access to one of the most spectacular wild regions of Canada. Initiated under a Roads to Resources Program, the highway is the major transportation route to the Mackenzie Delta. It also attracts highway travellers searching for a northern 'wilderness' experience. Along most of the highway, undisturbed natural ecosystems begin at the edge of the road right of way.

Wildlife, perhaps the quintessential indicator of wilderness, is visible along the highway. Some years, thousands of caribou of the Porcupine Herd winter near the highway in the southern Ogilvies and along the Ogilvie River. The diverse habitats along the highway are home to a wide range of other mammal and bird species. As part of the Beringian refugium, unique flora and microfauna can be found along the Dempster route. An interpretive centre at Tombstone Campground is open during the summer to introduce the travelling public to the wildlife and to the natural environment along the highway.

Development is limited along the route. There is only one commercial site on the Yukon portion of the Dempster highway. Only two government campgrounds are open to highway travellers in this reporting unit. NorthwesTel completed (in 1992) a system of microwave communications towers which provides an alternative land communication link to the western Arctic and improves communication along the highway.

The Dempster Highway Regulations provide a legal management tool for regulating development along this corridor and the Dempster Corridor Management Plan has provided some guidance to government for making land use decisions within the corridor. There are settlement lands along the highway which will be managed by First Nations following final land claim agreements. A no-hunting corridor is maintained one kilometre on either side of the highway and a grizzly bear closure is maintained approximately eight kilometres on either side. Access roads to the NorthwesTel tower sites are chained off to restrict vehicle access to the backcountry and help preserve the wildlife populations.

The no-hunting corridor and restricted facility development along the highway have so far maintained the 'wilderness' character of the road corridor. This highway has world-wide appeal for scientists, hikers, fishers, cyclists, birdwatchers, rockhounds and skiers. Opportunities for hiking abound along the highway. Numerous bus tours travel from Dawson to Inuvik every summer. Tourist traffic increased along the highway between 1987 and 1994.

Balancing the demands of a highly technological transportation and communication route and the wilderness values of the Dempster Highway will be of increasing importance as wildlands dwindle all over the world.

Harder To Say, Easier on the Environment

DDT replaced by the far less toxic and less persistent organophosphate insecticides for mosquito control in and around Yukon communities.

6.3 Central Yukon

This reporting unit includes the Klondike Plateau, Pelly Mountains, Yukon Plateau Central, and Yukon Plateau North ecoregions. Land cover of the central Yukon is primarily coniferous forests and arctic alpine tundra (Figure 6.10).

The Klondike Plateau includes a portion of the Tintina Trench and is characterized by smooth, unglaciated, rolling topography. Narrow dissected valleys of the Klondike Plateau continue to be the focus of the gold mining activity that began at Dawson City in 1896.

The Pelly Mountain ecoregion includes the Pelly and northern Cassiar mountains. Much of the region lies above the tree line and is characterized by alpine tundra vegetation communities.

The Yukon Plateau Central includes the area from Lake Laberge to Stewart River near Dawson. This region is composed of several groups of rolling hills and plateaus separated by deep, broad valleys. The south-facing grasslands produced by a generally semi-arid climate, and the veneer of volcanic ash over most soil surfaces are unique within boreal forests of Canada. This ecoregion includes the communities of Stewart Crossing, Pelly Crossing and Carmacks as well as the historic settlement of Fort Selkirk.

The Yukon Plateau North includes the Stewart, Macmillan and Pelly plateaus, and the south Selwyn Mountains. The terrain includes rolling uplands, small mountain groups, and level tablelands dissected by deeply-cut, generally broad, U-shaped valleys. The Tintina Trench, a steep-sided valley, traverses the ecoregion. The communities of Keno, Elsa, Mayo, Faro and Ross River are included in this ecoregion.

The entire central Yukon reporting unit has short, warm summers and severely cold winters, although the Pelly Mountains ecoregion is somewhat wetter and may experience midwinter mild spells. Central Yukon is home to a diversity of wildlife including caribou, grizzly and black bear, Dall and Stone sheep, mountain goat, moose, beaver, fox, wolf, coyote, ground squirrel, hare, raven, rock and willow ptarmigan and golden eagle. Salmon spawn in major rivers and streams of the Pelly, Stewart and Yukon basins, and freshwater fish include Arctic grayling, lake trout and whitefish. Many migratory birds, including sandhill cranes, pass over the central Yukon during migration.

Land use activities in the Central Yukon include hunting, trapping, recreation, tourism, mining and mineral exploration (Figure 6.11).

Figure 6.10
Land cover of ecoregions - Central Yukon

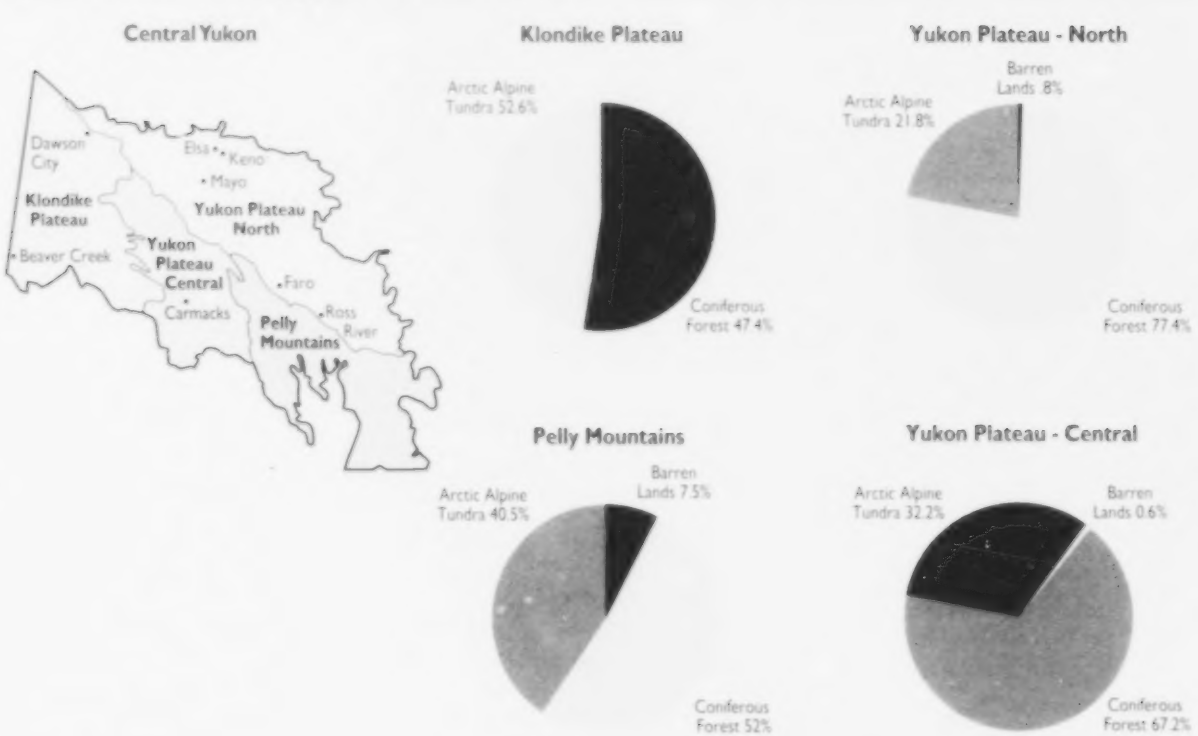
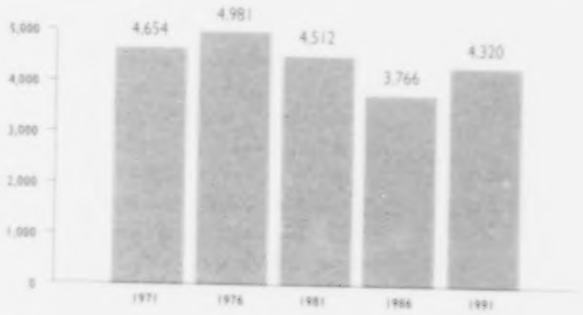
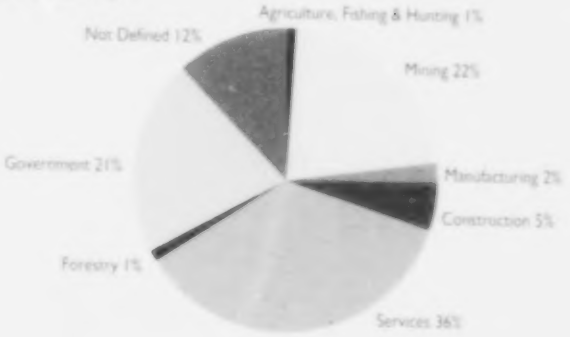


Figure 6.11
Population and employment - Central Yukon

Population of reporting unit, 1971 - 1991



Employment by industry 1991 census



Community populations December 1994

Beaver Creek	143
Carmacks	470
Dawson City	2,019
Faro	515
Mayo	472
Pelly Crossing	291
Ross River	392

Employment by sector, 1981 to 1991 census

Sector	1981	1986	1991
Primary - (e.g. hunting/mining)	885	520	630
Secondary - (e.g. manufacturing of crafts)	25	25	45
Tertiary - (government/retail services)	1,205	1,510	1,655
Not Defined	200	50	325
Total	**2,300**	**2,105**	**2,645**

While mining accounts for 22 per cent of the labour force in this reporting unit, tourism and related services are increasing. The historic Gold Rush community of Dawson City has drawn visitors since the turn of the century. As well, the history and the extensive wilderness areas of this region attract an increasing number of visitors to adventure tourism trips on the Yukon River, the Pelly and more remote areas such as the Macmillan.

The communities of Mayo and Elsa lost employment and business opportunities following the 1989 shutdown of the silver mine, which had operated since the 1920s. Placer mining remains active in the Mayo area, and residents have successfully promoted the Silver Trail highway route. The town of Faro also declined in population when the lead-zinc mine closed in 1992. The mine's reopening in 1995 has led to a revival of the community.

Changes in Traditional Land Use

The Central Yukon includes all or part of the traditional territories of seven of the 14 Yukon First Nations: Tr'on Dek Hwech'in, White River, Nacho Nyak Dun, Ross River, Selkirk, Carmacks Little Salmon and Ta'an Kwach'an. With the settlement of land claims and self-government agreements, First Nation

THE SEVENTIES

Beaufort Sea Oil

1971-77 The Berger Commission examined the development of Beaufort Sea Oil and the proposed North Slope pipeline.

governments will manage their own lands and cooperatively manage resources.

First Nations' main resource activities include harvesting salmon, trapping and hunting. Camps have been maintained for many generations at locations that are well suited to the harvest and preparation for storage of meat and fish.

One of the major changes brought about by the influx of non-natives to the Yukon over the past century has been the creation of year-round settlements. Many native people in the central Yukon have residences in communities but continue to make use of seasonal hunting and fishing camps and traplines.

Because this area is rich in mineral resources, more mines, access roads and mineral exploration camps have been established in the central Yukon than in any other part of the territory (see Section 3.11). Mining-related developments, and the increased use of the area that comes with a growing population, have resulted in conflicts with subsistence use. Traditional knowledge provides a means of identifying the types of disturbances that interfere with animal annual cycles and a way to identify areas that are key habitat for fish and wildlife. Ross River elder Charlie Dick points out the importance of mineral licks to moose of the Ross River-Finlayson Lake area.

[When hunting moose,] *some lick, pretty near every salt lick, you go in there, that mine open up in there everything scattered up. That's our food wasted away.*

Mount Mye, the site of the Faro mine development, was traditionally an important area to several families of the Ross River Kaska Dena because of the abundance of animal species key to their subsistence economy – moose, caribou, gophers, whistlers (marmots), freshwater fish and salmon. The area has a special place in Kaska lore because it is rare to find all of these species at the same location.

The development and operation of the Faro mine disrupted traditional land use.

Now no one goes there. The mine tore up half the mountain now. People from that country try other areas, could not find anything as good.

After that, just like people get lost, don't know where to go. They tried back in there, up that way. Not as good as down there no more. So people don't get good living like long time ago.

Arthur John, Ross River Dena Elder

The Ross River Kaska Dena have identified many changes to the area related to mine development and to the increase in Faro's population. Some of these are:

- decline in populations of some small mammals in the Mount Mye area, including: marten, fox, lynx, wolves, wolverine;
- decreases in big and small game populations on land accessible from Faro;
- depletion of freshwater fish populations in Swim Lakes (accessible from Faro); and
- limitations placed on access to areas traditionally harvested.[1]

In recent years, operators of the Faro mine have addressed some First Nation concerns by taking measures to preserve access for native harvesters, conserve habitat (see Section 4.3) and provide opportunities for economic benefits to the original inhabitants of Mount Mye.

Non-native Canadian society has changed in important ways since the 1960s when development of the Faro mine began. There is a general awareness of environmental issues surrounding mining and recognition of First Nations' rights to resources in their traditional lands. Environmental assessment legislation, court decisions recognizing aboriginal rights to hunt and fish, and land claims settlement legislation have entrenched these concepts in law.

Mining companies operating in the Yukon now identify and address potential environmental impacts from their mining projects and consult and negotiate with First Nations as part of the mine development process. The basic land use conflicts inherent in developing mines in areas of subsistence use remain, but the mechanisms to resolve them are in place. When a mine is developed or expanded, however, environmental impacts and conflicts with traditional land use also result from the influx of people and the increased road and trail access to areas that are outside of the mining area and the direct control of the mine developer. These impacts are not necessarily dealt with through existing review processes.

1972 THE SEVENTIES

1972 Kluane declared a National Park Reserve.

1972 Whitehorse Copper opened as an underground mine.

1974 Tailings dam failed at Cypress Anvil lead-zinc mine at Faro and tailings spilled into Rose Creek.

Mineral Potential, Mining and Environmental Issues

The central Yukon contains geological features that are particularly associated with the formation of mineral deposits. These features include faults – cracks in the earth's crust along which vertical or horizontal movement takes place – and terranes, large blocks of rock that have been moved from afar by geological forces. Volcanic activity associated with faulting, which produced the Tintina Trench, resulted in gold deposits at such places as Grew Creek. Important mineral deposits are found in the Yukon Tanana terrane. Examples are: the Casino deposit (copper-gold-molybdenum), the Carmacks copper deposit (copper-gold) and the Mount Nansen deposit (gold-silver).

Forces of erosion and deposition have concentrated secondary deposits of gold in river valleys. In most of the Yukon the glacial or ice-melt processes have dispersed the secondary gold deposits or covered them with thick layers of sediments. However, in the Klondike Plateau ecoregion there was little or no glaciation and the gold deposits are relatively undisturbed and easily accessible. Despite many years of exploration activity, the central Yukon is still relatively poorly understood from a geological perspective. It is considered to have great mineral potential.

Current placer and quartz (hard rock) claims in the Central Yukon are shown on Figure 6.12. Levels of activity vary on these claims, from minimal exploration work to recently-operated mines and mines in the development stage.

Figure 6.13 shows the locations of current hard rock mine development projects in the Central Yukon. Major mines that have operated in the past 10 years and mines that are planning to open in 1995 or 1996 are described below. Four mining properties that have filed project overviews or initial environmental assessments with the federal government are also marked on the map. Further information on these properties is in Table 6a.

Major Central Yukon Hard Rock Mining Properties

Faro Lead-Zinc Mine

The Faro mine is an open-pit lead-zinc operation mining sulphide ores, with a mill adjacent to the mined-out Faro pit.

Main environmental issues are related to decommissioning the mine. Tailings ponds are located in the Rose Creek valley behind a series of dams, with the creek diverted along the valley wall. Sections of pit walls, some of the waste rock dumps and all of the tailings are acid-generating or are predicted to become acid-generating. Decommissioning issues relate to the stability of the dams and diversions and to acid rock drainage. Drainage from the acid-generating sulphide waste rock and tailings becomes neutralized when it enters streams, but retains elevated levels of metals, primarily zinc. Zinc is toxic to fish and other aquatic organisms. Creeks below the mine complex support chinook salmon and arctic grayling, and planning for mine abandonment is directed towards the long-term protection of these fish. Acid rock

Placer Mining

Most historic and present-day placer mining is confined to the Klondike Plateau in the unglaciated areas of the Klondike, Sixtymile, lower Stewart and Indian river drainages. Of the 21 creeks that produced the most gold between 1978 and 1987, only three were not in these drainages. Placer mining is the use of gravity to recover valuable heavy materials, like gold, from a natural mixture of sand and gravel. Water is used to carry away unwanted material, leaving behind the gold, which is 19 times heavier than water. Modern placer mining uses heavy crawler tractors and large volumes of water to strip vegetation from gold bearing 'pay' gravels. These pay gravels are then washed or sluiced in high-pressure washing plants to recover the gold. Because placer deposits are associated with streambeds, much placer mining activity is within the floodplains of streams. Ground on terraces and wide flood plains is also mined. As a result, tailings piles, land stripped of vegetation and topsoil, settling ponds, and abandoned camps and equipment are common in the areas around placer mines.

THE SEVENTIES 1973

Land Claims Begin in Earnest

1973 *Together Today for our Children Tomorrow*, the land claim of the Yukon Native Brotherhood, published.

Elder Elijah Smith, one of the motivating forces behind Land Claims.
Whitehorse Star

Figure 6.12
Areas of current placer and quartz claims

Figure 6.13
Past producing hardrock mines and current mine development projects

Table 6.a
Proposed mining developments that had entered the environmental assessment stage by summer, 1995.

Property	Ore type	Proposed mine type/ore processing
Dublin Gulch	gold, non-sulphide ore	open pit/cyanide heap leach
Williams Creek	copper	open pit/acid heap leach
Minto	copper, gold, silver	open pit/mill
Kudz Ze Kayah	base metal sulphide ore	open pit, possible underground/mill

drainage from the site is dealt with during temporary closure and when the mine is operating by collecting and treating contaminated water prior to discharge to the environment.

Keno-Elsa Silver Mine

Silver and lead deposits have been mined at this underground and open-pit mine and mill since the 1920s. The mill last operated in 1989. Exploration and planning for the development of new deposits and for the eventual decommissioning of the mine site are underway.

Main environmental issues are related to acid rock drainage from adits and metals leaching from the tailings ponds. Drainage from some adits is high in metals (primarily zinc). Since the mine's shutdown, the new owners have taken measures to control and treat drainage from the adit that had the most effect on downstream water quality. Main concerns are related to the long-term control of this drainage to protect habitat in the McQuesten River.

Ketza River Gold Mine; Grew Creek Gold Deposit

This underground and open-pit gold mine and mill operated from 1988-1990. The owners are proposing to reopen the mill to process oxide ore from the Grew Creek property, between Ross River and Faro.

Main environmental issues at the site have been long-term stability of the tailings dam and creek diversions, the potential for arsenic release from the tailings pond following mine decommissioning, and water quality while the mine is operating. The gold milling process used cyanide, which is broken down by a process that produces ammonia. Both cyanide and ammonia effluent levels require careful control to protect fish downstream of the mine in Cache Creek and the Ketza River. Only oxide ores have been mined and milled at the site, and there are no concerns related to acid rock drainage. There is extensive trenching on mountain sides.

Mount Nansen Gold Mine

This is an underground mine and mill with several relatively small sulphide and oxide deposits. The mine operated briefly from 1968-69 and for 10 months in 1975/76. Plans are to reopen the mine in 1996 after refitting the old mill.

Main environmental issues are long-term stability of the tailings dam, the potential for arsenic release from the tailings pond following mine decommissioning, and water quality when the mine begins operations. The proposed new operation at this site would develop an oxide deposit and expose little acid-generating rock. The older operations did mine some sulphide rock and there is some concern about acid generation from an existing waste dump at the site. There has been extensive land disturbance from exploration, including trenching, in the area.

Brewery Creek Gold Mine

This new open-pit heap-leach gold mine is slated to open in 1996. Instead of a conventional mill, the ore will be processed by placing it on an impermeable pad and percolating a cyanide solution through the ore. The gold is leached from the ore by the cyanide solution and then recovered from the solution. The cyanide solution is recycled back to the ore 'heap'.

Main environmental issues have been related to the potential for breaks or leakage in the heap leach system, which could release cyanide to the environment. The heap leach process produces no tailings, but leaves ore piles which may contain residual cyanide, and sludge ponds which may leach arsenic and antimony. Mitigation measures developed through the review and licensing of the mine addressed these concerns through provision of safeguards and monitoring of the system. No dams or major stream diversions are required at this time.

Mine Abandonment

When mineral resources are depleted or when world metal markets or financial climate make mining uneconomical, mines shut down. Often the same mines re-open a few years later when conditions improve or when a new owner obtains financial backing.

DIAND recently completed an inventory of wastes in the Yukon and an assessment of abandoned mines and mine exploration camps in the territory. Figure 6.14 summarizes the results of these studies for the central Yukon and shows information provided by Environment Canada. Properties with active exploration or under development are not included, as they are not considered abandoned.

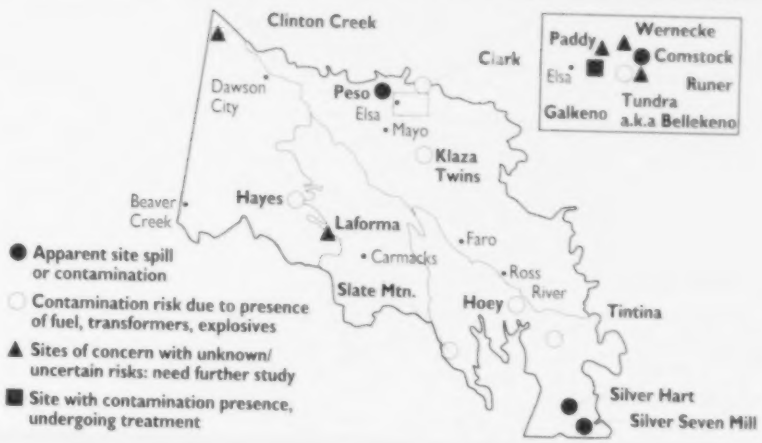
Sites shown on the map are those identified in the assessment as high priority for reclamation work related to environmental protection. Sites are classified according to the type of environmental concern:

1. apparent spill or site contamination: e.g. fuel spill, vegetation damage;
2. contamination risks due to presence of fuel, transformers, explosives;
3. sites of concern with unknown or uncertain risks due to lack of environmental data (these sites typically have waste rock piles or tailings or showed some signs of vegetation stress, which can be a result of acid rock drainage).

Clinton Creek Asbestos

The Clinton Creek asbestos mine, in the Forty Mile River drainage basin near Dawson City, operated between 1968 and 1971. The water licence has expired, the mine has been abandoned, and the company that operated the mine is no longer in exsistence. Tailings piles remain adjacent to the creek. These piles are unstable and are sliding into the creek, creating impoundments. The main concern is that the impoundments might crumble, flushing tailings further down the creek.

Figure 6.14
Abandoned and inactive mines and exploration camps



6.4 Southwest Yukon

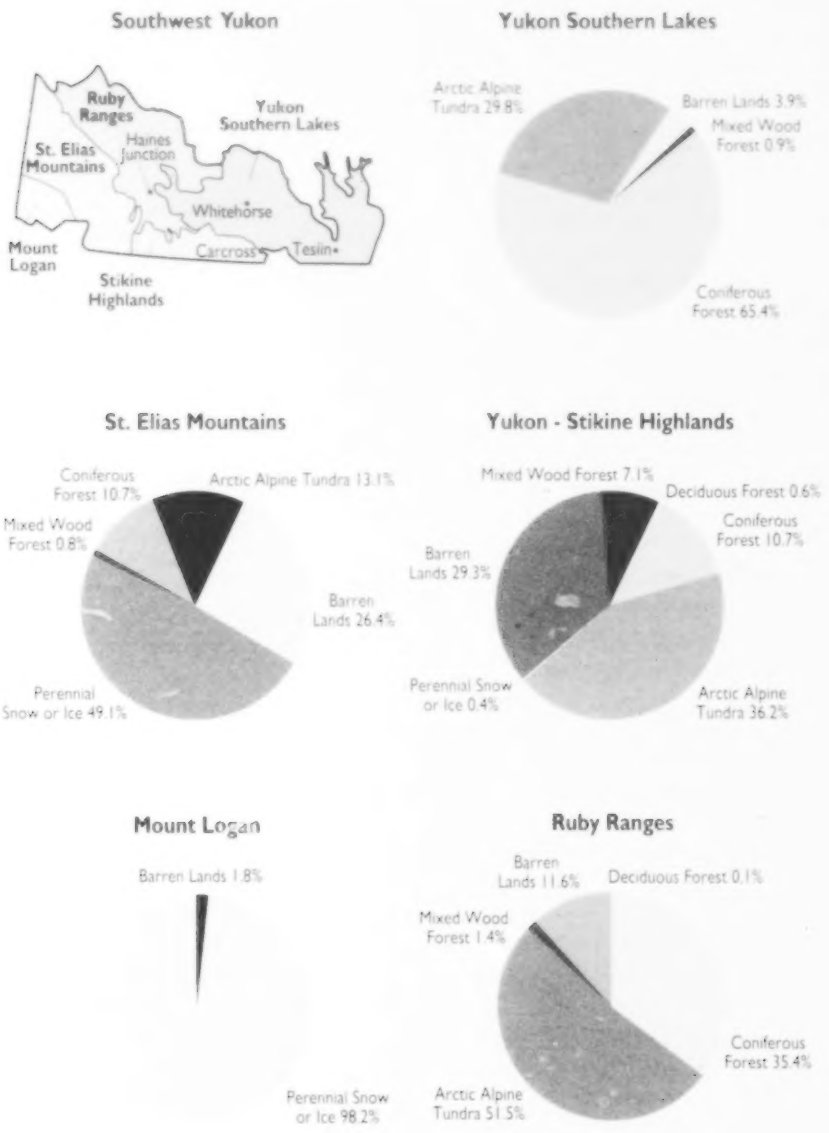
This reporting unit includes six ecoregions ranging from Mount Logan, (with a landcover of 98 per cent perennial snow and ice), to the Yukon Southern Lakes, a region characterized by coniferous forests (Figure 6.15). Mount Logan, at 5,959 metres, is the highest mountain in Canada, while a half dozen other peaks in the area also exceed 4,000 metres. Several prominent glaciers span a distance of 100 km from their source in Canada to Alaskan tidewater.

Most of the St. Elias Mountains, as well as the Mount Logan ecoregion, are included in the Kluane National Park. The Ruby Range ecoregion consists of rolling to undulating hills, with northern cordilleran boreal forests on the lower slopes and valleys.

Yukon Southern Lakes ecoregion extends from Lake Laberge south to the British Columbia border. Most of the ecoregion lies between 600 and 1,500 m in elevation. The climate is moderated by coastal influences with low precipitation because of the region's location within the rain-shadow of the St. Elias Mountains.

The Yukon Stikine Highlands are composed of three ecoclimates: alpine tundra, subalpine forests and closed forests. This is a transitional zone

Figure 6.15
Land cover of ecoregions - Southwest Yukon



Aishihik Dam

Aishihik Lake Dam constructed. As expected, the irregular flow of water results in the loss of the rainbow trout population, estimated at 1,500 fish. Restocking and experimental winter flows started in 1993 to restore this population.

Otter Falls in 1969, before the dam.

between the coastal and interior regions and is characterized by subdued mountains and wide valleys.

Wildlife in the southwest is diverse, including grizzly and black bear, caribou, Dall and Stone sheep, mountain goats, moose, deer, beaver, fox, wolf, wolverine, snowshoe hare, marmot, pika, ground squirrel, raven, rock and willow ptarmigan, and golden eagle. Elk and wood bison have also been introduced into the region.

Most of the Yukon's population is found in the southwest (Figure 6.16). Approximately 23,000 people live in Whitehorse and about 1,500 live in the surrounding area. Population growth has been rapid, especially in the past seven years, when a 26 per cent increase in population occurred. Many residents value a lifestyle that includes access to wilderness areas for recreation or traditional activities. Impacts from our increasing population are beginning to show in a variety of ways, through the wastes we release, the declining resources (fuelwood, fish and wildlife) and limited land for development.

First Nation people witnessed dramatic changes with the construction of the Alaska Highway. The road development that began in the 1940s had a major impact on wildlife populations, as well as the seasonal round of hunting and gathering, which had been part of the traditional lifestyle. Martha Van Heel, a Teslin Tlingit Elder explains: *And when the highway came through, that really scared game. Everything harder to get.*

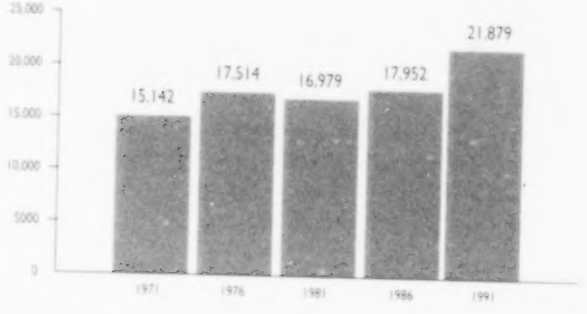
She also speaks of the effect of highway dust. *We use the wild sage for seasoning, like for boiling or roasting. And for spinach, I know that we use dandelion leaves and get some wild onions and bear roots. Now they just go to the store because we can't get plants near town. We have to go way out to get away from the pollution.*

One might think a relatively small population and vast spaces would limit land use conflicts. Conflicts occur in this region, however, since much of the valuable land for residential, agriculture and wildlife habitat is located in valley bottoms.

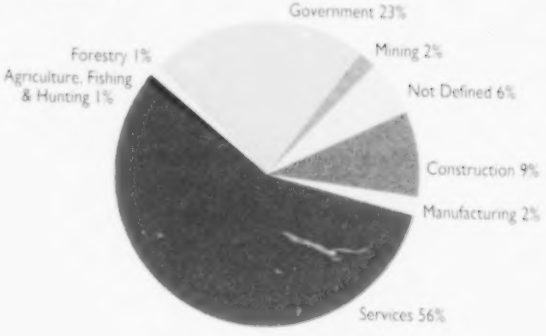
Large carnivores have adjusted poorly to development in southern Canada in the last century and this heightens the importance of Yukon wolf and bear populations. Grizzly bears are vulnerable to development in several ways. They require large areas for foraging, and females mature at a late age and have relatively few young. Bears are frequently attracted to garbage at municipal waste sites, which is an additional risk for them.[1] A bear-proof electric fence at the Haines Junction municipal dump helps stop the routine destruction of bears from the surrounding area, including grizzly bears from Kluane National Park. Electric fencing is planned for several other Yukon municipal dumpsites.

Figure 6.16
Population and employment - Southwest Yukon

Population of reporting unit, 1971 - 1991



Employment by industry 1991 census



Community populations December 1994

Burwash Landing	76
Carcross	421
Destruction Bay	45
Haines Junction	796
Tagish	134
Teslin	465
Whitehorse	22,911

Employment by sector, 1981 to 1991 census

Sector	1981	1986	1991
Primary - (agriculture/fishing/hunting; mining and forestry)	605	540	460
Secondary - (manufacturing)	245	275	320
Tertiary - (construction; government; services)	8,515	9,145	11,875
Not Defined	675	725	765
Total	**10,060**	**10,690**	**13,425**

It would be misleading to suggest that human activities are responsible for all environmental concerns in this region. In geological terms, the landscape of the southwestern Yukon is young. The area is the most seismically active in Canada and the mountain topography creates terrain hazards such as landslides. Many of the glacially-fed waterways carry a heavy sediment load and are prone to flooding.

The groundwater supply in Carcross was the subject of concern in the mid-1980s. Testing of well water indicated that arsenic, a naturally occurring poisonous element, was showing up in samples. Arsenic levels were approaching the unacceptable limit for drinking water (over 0.05 parts per million) and steps were eventually taken to bypass the groundwater source containing arsenic and obtain supplies from an intake in Lake Bennett.

We can gain a useful perspective on how humans affect the environment over time by looking at the traditional knowledge of First Nations. The Aishihik Lake area in southwestern Yukon has a long, rich history with the Champagne-Aishihik First Nation centred around Aishihik Village. Elders offer two reasons for the village's location: the best fishing areas were at the north end of Aishihik Lake adjacent to the village; and, caribou, moose, and sheep were found in prime hunting areas nearby. Aishihik River was dammed in 1975, changing the natural water levels in Aishihik Lake. When the operation began, many people were concerned

Global Links: A Yukon Perspective

Most Yukoners now recognize that activities in other parts of the world can have impacts on our local systems. For example, industrial contaminants from outside the Yukon can be carried here by air currents and enter the food chain through Yukon lakes. These and other types of global-scale stresses such as climate change will alter the natural world in unpredictable ways. Long-term monitoring programs enable us to detect, and perhaps respond to these changes. There are several examples of these research projects in the southwest Yukon.

Canadian Glacier Inventory:

The Icefield Ranges in the southwestern Yukon make up the largest network of subarctic glaciers in the world. Global warming may increase melt rates and this in turn may contribute significantly to a global rise in sea level. The glaciers found in the southern part of the St. Elias Range have been mapped as part of the Canadian Glacier Inventory and this will provide a baseline that scientists can use to monitor future changes.

Kluane Boreal Forest Ecosystem Project:

Since 1976, researchers from several Canadian universities have been studying the 10 year cycle of snowshoe hares (see Section 4.3). The hare cycle occurs throughout the Canadian boreal forest, although the reasons for this natural oscillation are not well understood. The basic research goal of the Kluane project is to describe the interactions between key parts of the ecosystem. At the base of the food chain are such factors as plant production and soil nutrients. At the top are predators, with herbivores such as the snowshoe hare playing a key role in the middle.

Grizzly Bear Ecology in Kluane National Park:

This project is concerned with whether bear populations both within and beyond the park boundaries are being harmed by human-bear conflicts. In 1992, a large-scale research project on grizzly bears was started to gather baseline information on their populations. Early results revealed that about one-third of tagged bears moved back and forth across the park boundary. Between 1992 and 1993, three of these 'transboundary' bears were destroyed when they ran into conflicts with humans outside the protected areas of the park.

1979 THE SEVENTIES

Blue Lynx

Last year I trap was '46, prices no good. But 1979-80, I saw it in the paper where the blue lynx was fourteen hundred bucks. I couldn't believe it. I remember when I was a kid I catch a blue lynx got twenty bucks for it. Twenty bucks, I thought I owned the world.

— Bob Watson, Watson Lake Elder

about high water levels; however, biologists now suspect low water conditions also have significant effects.

Lake whitefish and lake trout can live for over 35 years. They reach sexual maturity before their 'teens' and reproduce annually during an autumn spawning period. Fisheries biologists used a technique of age class analysis to determine the age of individual lake whitefish. They found that, since hydro operations started, there have been some years where few lake whitefish survived to join the adult population (Figure 6.17). These 'recruitment failures' seem to be associated with low lake levels.

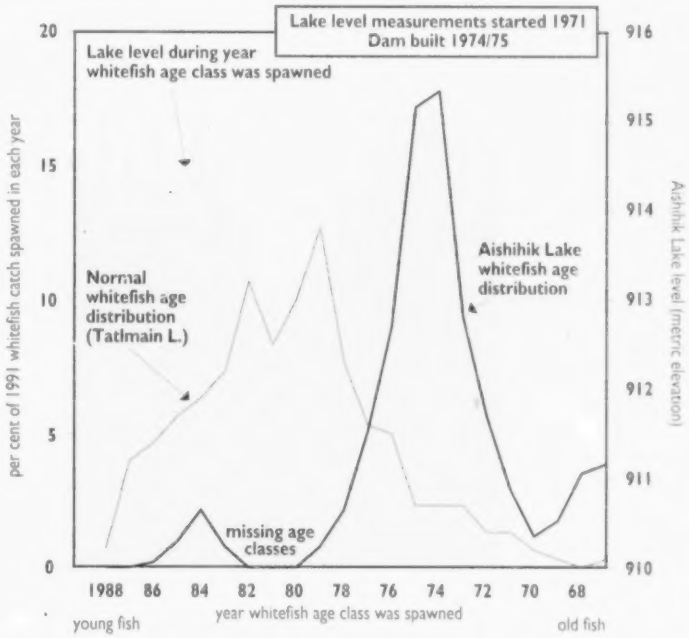
The loss of young age classes for several years in a row can have a significant effect on a fish population. The loss of an occasional year class can occur naturally because of changing environmental conditions. Water management and lake drawdown during low precipitation years may aggravate the impact of natural environmental factors resulting in the loss of more year classes of fish. Because lake trout feed mainly on whitefish (lake whitefish and round whitefish) in Aishihik Lake, any serious reduction in whitefish numbers could have a negative effect on the lake trout population. The age distribution and population characteristics of Aishihik Lake lake trout, however, appear to be comparable to other Yukon lakes.

Studies continue on the Aishihik system to identify causes of whitefish recruitment failure and options for mitigation.

Residents report that the region has changed in recent years and Champagne-Aishihik First Nation members encounter difficulty in pursuing traditional harvest practices. During the late 1980s local First Nations reported declining moose and caribou numbers in Aishihik region. Woodland caribou had declined by approximately 40 per cent between 1981 and 1991. Eventually, licensed hunting was stopped, First Nations voluntarily curtailed their subsistence harvest and, in 1992, the Aishihik Caribou Recovery Program was started (see Section 4.3).

Figure 6.17
Ages of whitefish in relation to Aishihik Dam

This graph compares Aishihik Lake whitefish age classes to those of Tatlmain Lake. It shows reduced or missing age classes at Aishihik and a normal range of age classes at Tatlmain. A reduced or missing age class means that most or all fish spawned in a particular year did not survive or that spawning was not successful. The shaded area shows water levels of Aishihik Lake over this period.



Note: The number of young fish in both lakes appears low because few of these small fish are caught with the fishing gear used for sampling.

THE EIGHTIES 1984

1979 Dempster Highway completed.

1984 Inuvialuit Final Agreement contained provisions for conservation and wildlife management on the Yukon's North Slope.

1986 Ivvavik National Park proclaimed as part of the Inuvialuit Final Agreement.

Global Links: A Yukon Perspective

Canadian Glacier Inventory

Kluane Boreal Forest Ecosystem Project

Grizzly Bear Ecology in Kluane National Park

1979

Blue Lynx

Figure 6.17
Ages of whitefish in relation to Aishihik Dam

This graph compares Aishihik Lake whitefish age structure to those of Tatchun Lake. It shows reduced or missing age classes in Aishihik and a missing cohort of age classes in Tatchun. A reduced or missing age class means that most or all fish spawned in a particular year did not survive to that spawning age class successfully. The shaded area shows years of Aishihik Lake dam operation.

Lake trout spawning age
Aishihik Lake dam operation (1975-Present)
Missing age classes
Aishihik Lake whitefish age distribution
Missing whitefish age distribution (Tatchun L.)
Missing age classes

Note:

1979 Dempster Highway completed.

1984 Inuvialuit Final Agreement completed, provisions for conservation and wildlife management on the Yukon's North Slope.

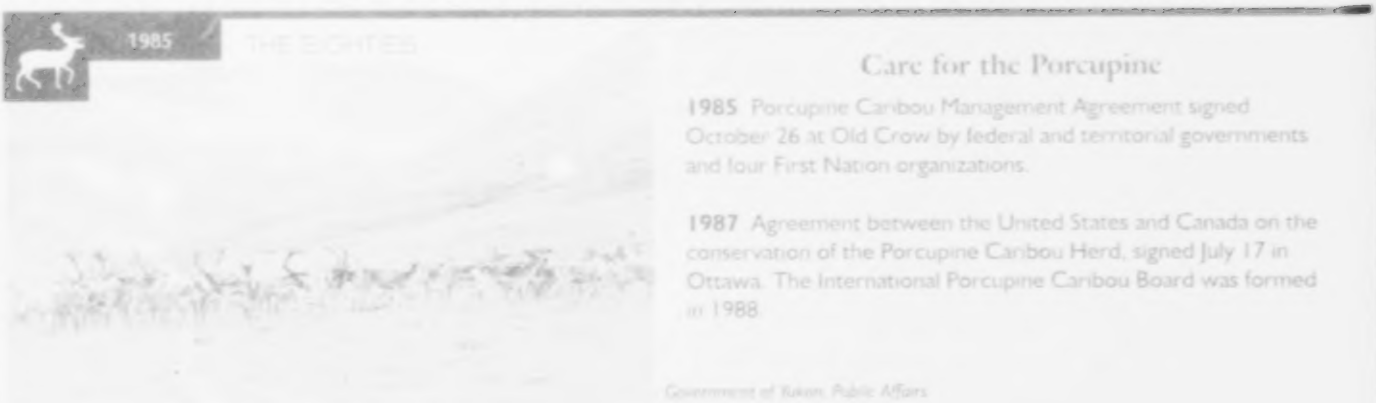
1986 Ivvavik National Park proclaimed as part of the Inuvialuit Final Agreement.

Whitehorse Urban Area

Whitehorse Urban Air Quality

Figure 6.18
Whitehorse's population

Figure 6.19
Developed land in Whitehorse, 1991



Care for the Porcupine

1985 Porcupine Caribou Management Agreement signed October 26 at Old Crow by federal and territorial governments and four First Nation organizations.

1987 Agreement between the United States and Canada on the conservation of the Porcupine Caribou Herd, signed July 17 in Ottawa. The International Porcupine Caribou Board was formed in 1988.

Whitehorse Urban Area

The Whitehorse area has been occupied by humans for centuries. There is evidence of old settlements upstream of Miles Canyon and downstream of Whitehorse Rapids. Kwanlin Dun, the name of one of the Whitehorse First Nations, is Southern Tutchone for "water running through canyon".

During the Gold Rush, tent cities were established at Canyon City and on the east bank of the Yukon River where Riverdale is now located. The new settlement of Whitehorse later expanded to the present downtown area. The population of Whitehorse remained at about 1,000 from 1901 to the 1940s when construction of the Alaska Highway precipitated considerable growth throughout the Yukon (Figure 6.18).

The city experienced increased population growth from 1951 to 1991, partly due to the 1953 relocation of the Yukon capital from Dawson City to Whitehorse and partly due to expansions of the Whitehorse boundary to include rural residential areas. In 1991, Whitehorse had a land area estimated at 420 km^2 and a density of 43 persons per km^2. Of the total land area, only 24 km^2 or approximately six per cent of the city is developed (Figure 6.19).

Whitehorse Urban Air Quality

Although the air over downtown Whitehorse is usually very clean, Whitehorse is subject to episodes of poor air quality. Vehicle use and wood burning are contributing factors. During the winter, when the weather is calm and cold, warmer air above the city can trap the colder air at ground level for hours or days. These temperature inversions lead to a temporary build-up of gaseous pollutants and fine particles in the air.

Air quality data are collected downtown and in Riverdale, a neighbourhood that is particularly susceptible to temperature inversions. The Wood Smoke By-law was enacted in 1986 authorizing the city to enforce no-burn periods for wood stoves in Riverdale during temperature inversions.

In general, the Yukon burns a higher percentage of wood per capita than other jurisdictions in Canada (Figure 6.20). It is estimated that 64 per cent of the 5,040 households in Whitehorse use wood heat. The number of wood heating appliances increased by 85 per cent from 1979 to 1982 (Figure 6.21). The other main source of air pollution in Whitehorse is vehicle exhaust.

Figure 6.18
Whitehorse's population

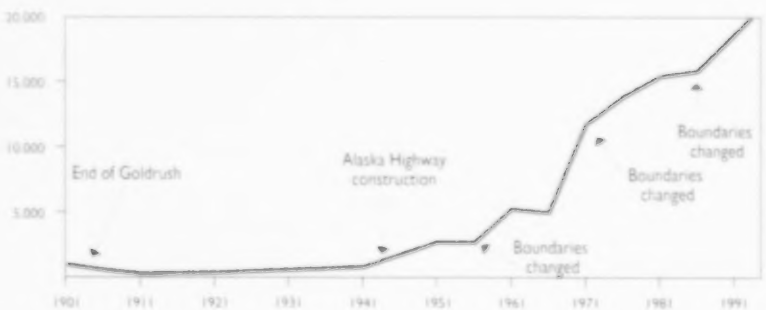


Figure 6.19
Developed land in Whitehorse, 1991

Developed Land
Developed land = 24 km^2 or 6% of the city's total land area
Urban use = 9.5 km^2 or 40% of all developed city land
Rural use = 14.5 km^2 or 60% of all developed city land
Undeveloped Land
Undeveloped land = 396 km^2 or 94% of the city's total area of 420 km^2

Government of Yukon, Public Affairs

Care for the Porcupine

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1987 Agreement between the United States and Canada on the conservation of the Porcupine Caribou Herd, signed July 17 in Ottawa. The International Porcupine Caribou Board was formed in 1988.

In this section we review information from the downtown Whitehorse air quality station for total suspended particulates (TSP) and for two gaseous pollutants – carbon monoxide (CO) and nitrogen dioxide (NO_2). The downtown Whitehorse air quality station is part of a national network that monitors urban air quality. Gaseous pollutants are measured from late fall to early spring only (from 1985 on); particulates are measured year-round. The Whitehorse air quality station was shut down in 1992–93. Data collected since the station restarted have not yet been analysed.

Is the Air Safe to Breathe?

This question is best answered by comparing Whitehorse air quality data with national air quality objectives. These objectives were developed by the Canadian government and are based largely on considerations of human health. The health risks are determined by the type of pollutant, the pollutant concentration and the length of exposure. Thus, for each pollutant there are several objectives corresponding to 'good' (no effects), 'fair', 'poor' and 'very poor' air quality ranges. Whitehorse air is usually in the 'good' range for all pollutants measured. However, periods of 'fair' or 'poor' air quality occur as a result of episodes of high levels of CO, NO_2 or TSP.

Vehicles are probably the major source of CO and NO_2 in the Whitehorse air, although home and commercial heating are also significant sources, especially of NO_2. Carbon monoxide is a common air pollutant and is usually present in the atmosphere at low concentration. At higher levels, this colourless, odourless gas can represent an acute health risk. Nitrogen dioxide is a reddish-brown gas that people can smell. At elevated concentrations, NO_2 can adversely affect human health, vegetation, materials and visibility. Children and people with respiratory diseases can be particularly sensitive to NO_2 gas.

The data from the downtown monitoring station show that Whitehorse frequently has periods during winter when CO levels do not meet the objective for 'good' air quality (Figure 6.22). It is important to recognize that, even when CO gas concentrations are at their highest levels in downtown Whitehorse, the air is still of 'fair' quality, and there should be no detectable human health effects.

Figure 6.20
Principal heating methods in Canada and Yukon

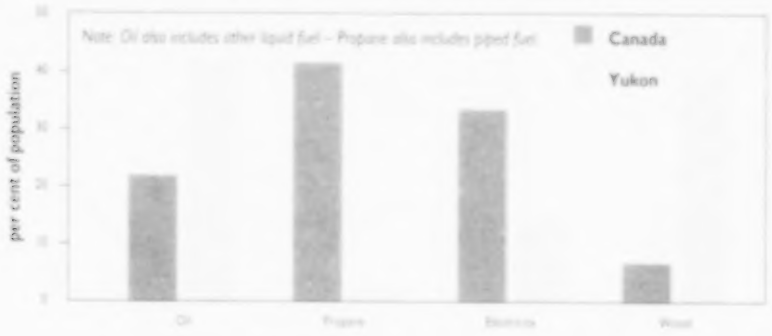
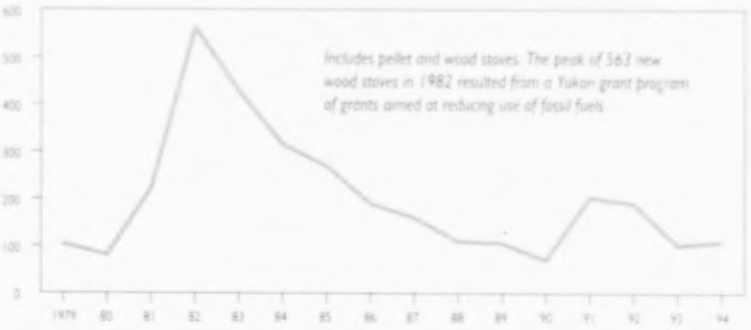


Figure 6.21
Number of new wood stoves installed 1979 to 1994



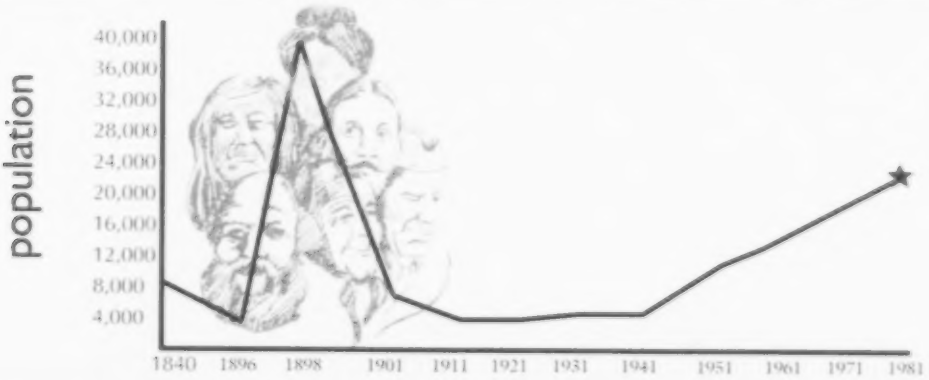


Figure 6.22
Trends in carbon monoxide (CO) levels, Whitehorse

Downtown Vancouver, consistently one of the worst locations for carbon monoxide levels in Canada, has improved dramatically since 1985. The trend is less clear for Whitehorse. Of the 54 Canadian stations measuring CO, Whitehorse ranked 7th to 15th worst each year in terms of high CO events. High CO events are 8-hour periods when CO levels put air quality into the 'fair' range (Whitehorse), or 'fair' or 'poor' range (Vancouver).

Whitehorse is one of the few monitoring stations in Canada where nitrogen dioxide concentrations sometimes reach unhealthy levels. This is indicated by the occurrence of episodes when concentrations for 24-hour periods result in 'poor' air quality (Figure 6.23). These events seem to be infrequent and they are difficult to explain. They may be related to year to year changes in weather or vehicle use, and instrument error has not been discounted.

Total suspended particulates (TSP) is a measure of all sizes of suspended particles, including fine particles of smoke and exhaust, and windblown dust. Particles in air reduce visibility, cause soiling, and, at higher levels, affect people with respiratory problems. The annual mean TSP level has declined steadily since the 1970s (Figure 6.24), and is generally in the 'good' range. However, Whitehorse continues to experience occasional 24-hour periods when the TSP level places air quality in the 'poor' range. Although occasional high levels in the winter may be related to wood smoke and vehicle exhaust, the highest average TSP levels in Whitehorse occur each year in the early spring when dust is blown through the city streets just after the snow has melted.

Air pollutants will continue to be monitored. We know there will be more vehicles, but this does not necessarily mean more pollution. Newer vehicles, if well maintained, release far less CO and NO_x than do older, poorly-maintained vehicles. A

Vehicles in Whitehorse 1995

- There are a total of 17,232 vehicles in Whitehorse.
- Whitehorse accounts for 83.6% of all vehicles in Yukon.
- There are 1.2 vehicles for every driver in Whitehorse.

recent study in Ontario concluded that about 50 per cent of total vehicle emissions may be produced by about 10 per cent of the province's vehicles.

Fuelwood Cutting

Wood burning for home heating influences air quality. As well, fuelwood harvesting has an environmental impact on areas surrounding Whitehorse. Based on an annual estimate of five cords of wood for each wood-burning appliance, approximately 16,000 cords of wood are used each year in Whitehorse. As the Takhini Burn wood supply diminished, fuelwood close to the city became scarce. This has forced domestic and commercial cutters to drive further for wood supplies. It has also resulted in the overuse of the few remaining wood-cutting areas close to the city. The Long Lake area has been particularly affected by wood cutting with a proliferation of bush roads causing damage to new tree growth.

1985 THE EIGHTIES

Mosquito larva

Bugs Bombed by Bacillus

Vetobac, made from the bacterium *Bacillus thuringiensis israeliensis*, used for mosquito larva control in place of chemical pesticides.

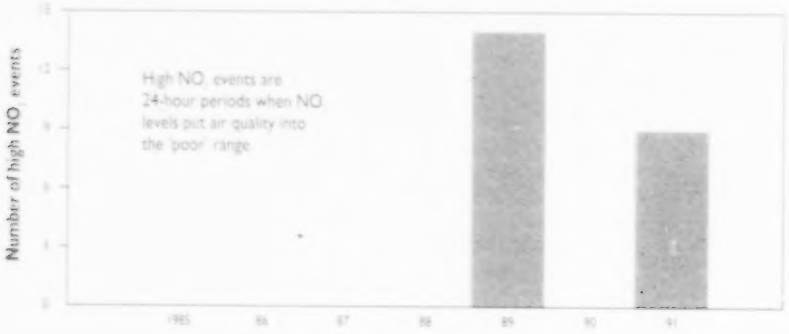
Public and Alternative Transportation

Whitehorse is sparsely populated making it difficult to provide economic public transportation. Bus ridership in Whitehorse averages one person per kilometre of travel based on a monthly total ridership of 40,000. Public transportation is available only within the urban residential areas. The city is evaluating the potential for increased service, including an assessment of buses equipped with bike racks.

The increased use of alternative transportation is thought to be low, although there is some indication that cycling is increasing slightly. The lack of developed bike paths, long distances between destinations, and cold, long winters limit the use of bicycles. In an effort to encourage cycling, the city is reviewing the status and opportunities for development of bike paths.

Figure 6.23
Trends in nitrogen dioxide (NO_2) levels, Whitehorse

Although Whitehorse's NO_2 levels are usually in the 'good' air quality range, episodes of 'poor' quality occurred during two recent years. These events are unusual in Canada. For example, Whitehorse and Calgary were the only stations with high NO_2 levels at any time during 1991.



Electricity

Total consumption of electric power in Whitehorse was 186 million kilowatts in 1994. Residential and commercial use are roughly equal. Government use is included in the commercial category (Figure 6.25).

Water Use and Quality

Whitehorse had been labelled the water hog of Canada, an unfortunate title based on the average water consumption rate. However, studies have shown that

Figure 6.24
Total suspended particulates (TSP) levels, Whitehorse

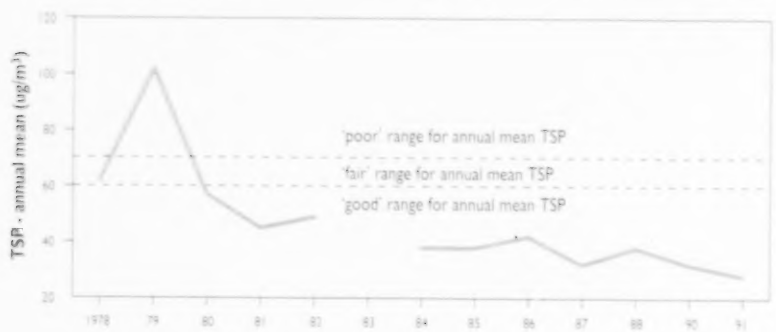
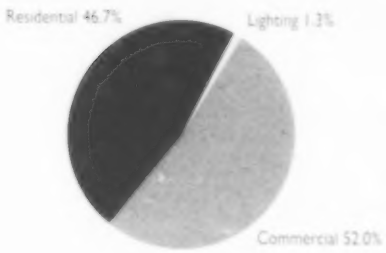


Figure 6.25
Whitehorse electricity consumption, 1994



THE EIGHTIES 1986

Return of the Wood Bison

34 wood bison were introduced to the Nisling valley. The species had not been seen in the Yukon for hundreds of years.

Alsek is designated a Canadian Heritage River.

Figure 6.22
Trends in carbon monoxide (CO) levels, Whitehorse

Downtown Vancouver consistently one of the worst locations for carbon monoxide levels in Canada, has improved dramatically since 1985. The trend is very clear for Whitehorse. Of the 34 Canadian stations measuring CO, Whitehorse ranked 7th or 13th worst each year in terms of high CO events. High CO events are 8-hour periods when CO levels put air quality into the 'fair' range (Whitehorse) or 'poor' or 'very poor' range (Vancouver).

Vehicles in Whitehorse 1995

- There are a total of 17,232 vehicles in Whitehorse.
- In summer, a quarter to one-third of vehicles are tourists.
- There are 1.2 vehicles per household in Whitehorse.

Fuelwood Cutting

1985

Mosquito larva

Bugs Bombed by Bacillus

Vetobac, made from the bacterium *Bacillus thuringiensis israeliensis*, used for mosquito larva control in place of chemical pesticides.

Public and Alternative Transportation

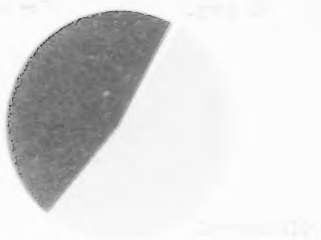
Figure 6.23
Trends in nitrogen dioxide (NO_2) levels, Whitehorse

Electricity

Water Use and Quality

Figure 6.24
Total suspended particulates (TSP) levels, Whitehorse

Figure 6.25
Whitehorse electricity consumption, 1994



1986

Return of the Wood Bison

34 wood bison were introduced to the Nisling valley. The species had not been seen in the Yukon for hundreds of years.

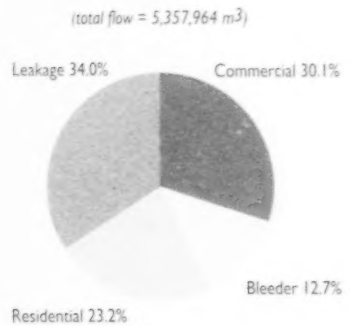
Alsek is designated a Canadian Heritage River.

leakage of treated water accounted for 34 per cent of use, and bleeders (used to prevent frozen pipes) accounted for 12.7 per cent (Figure 6.26). As well, this calculation did not take into account residents outside the city who receive water delivery or use of city water for dust control on roads. When the leakage and water loss through bleeders was removed from the consumption total, Whitehorse per capita annual residential water use was calculated at 321 m^3, only 2.2 per cent higher than the average use in 10 western Canadian cities.

Although the city has conducted water conservation projects, there is little incentive to save water as resident users pay a flat fee for water. To reduce water consumption, the city enacted a by-law requiring that all new construction and retrofitting include low flush toilets. The city's aging water delivery infrastructure is being upgraded to reduce leakage, and bleeders are not allowed in new home construction.

The main year round water source for Whitehorse is Schwatka Lake, a hydro electric impoundment on the Yukon River. In the winter, warmer ground water is mixed with lake water to decrease the reliance on water heaters at the pumping stations; in summer ground water is used to reduce sediment content. Water quality is monitored for faecal and total coliform bacteria. The recommended guideline for raw drinking water is no more than 10 organisms per 100 millilitres of water for total coliform and no occurrence of faecal coliform bacteria. Levels of bacteria in the water intake sometimes exceed this guideline, especially in the spring. The frequency of high coliform bacteria levels in samples has increased in recent years. Growing residential, recreational and industrial development upstream from the city may contribute to high bacteria counts, along with natural sources, such as birds.

Figure 6.26
Whitehorse water use, 1993



Sewage Disposal

Whitehorse has three sewage treatment systems: the Whitehorse and Porter Creek lagoons, which discharge continuously into the Yukon River, and the Crestview system which discharges to the ground. The Whitehorse system is being upgraded and is expected to result in improved water quality downstream of Whitehorse (see Section 2.2).

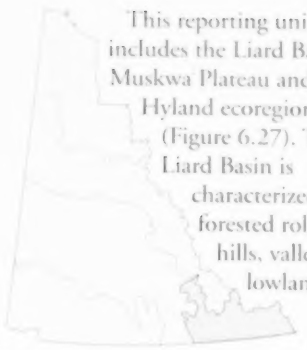
Measures Promoting Sustainability Within the City of Whitehorse

- installation of a wind generator on Haeckel Hill
- inventory of habitat areas within the city to assess need for protection
- more emphasis on tree planting in the downtown core
- assessment of alternative transportation modes
- support for composting and recycling to reduce the total waste in Whitehorse

Legacies from the Past

- Improper handling of solid waste – first directly into the river, then over the river bank at Range Road, then burned and put into the War Eagle pit; currently solid waste is disposed of in a landfill with separation of recyclables, compostables and hazardous wastes.
- Tar pit left from the World War II oil refinery; clean-up is still being addressed.
- Whitehorse copper mine where tailing ponds cause dust problems; revegetation program underway.
- Waste disposed of at Crater Lake; waste collected and disposed of in a clean-up by volunteers in 1993.
- Abandoned vehicles in greenbelts and open space areas; 1994 program organized to remove and recycle the metals.
- Contaminated soil in the downtown area has affected indoor air quality in MacBride Museum and Yukon Government Building.

6.5 Southeast Yukon



This reporting unit includes the Liard Basin, Muskwa Plateau and the Hyland ecoregions (Figure 6.27). The Liard Basin is characterized by forested rolling hills, valleys and lowlands with the highest potential for forest products in the Yukon. The Hyland ecoregion is characterized by low relief and broad undulating plateaus and hills. The valleys are narrow and deeply incised with very little of the terrain extending above the treeline. A small portion of the Muskwa Plateau is included in the most easterly portion of Central Yukon. This is a boreal mid-cordilleran ecoregion occurring along the foothills of the Rocky Mountains in northeastern British Columbia, a corner of the Yukon and spanning the border with the Northwest Territories.

This reporting unit includes the communities of Watson Lake and Upper Liard (Figure 6.28). Watson Lake has a diversified economy primarily based on the service sector, where employment from retail sales and services is most likely related to tourism. Only two per cent of the population was employed in forestry in 1991 (this was atypical due to the Watson Lake sawmill closure); timber harvesting in the Watson Lake region that year was approximately one-sixth the size of the harvest in 1994/95.

Upper Liard is a traditional settlement established during the fur trading era. This community, located 10 km north of Watson Lake, also supports forest activities along with subsistence use by the local residents.

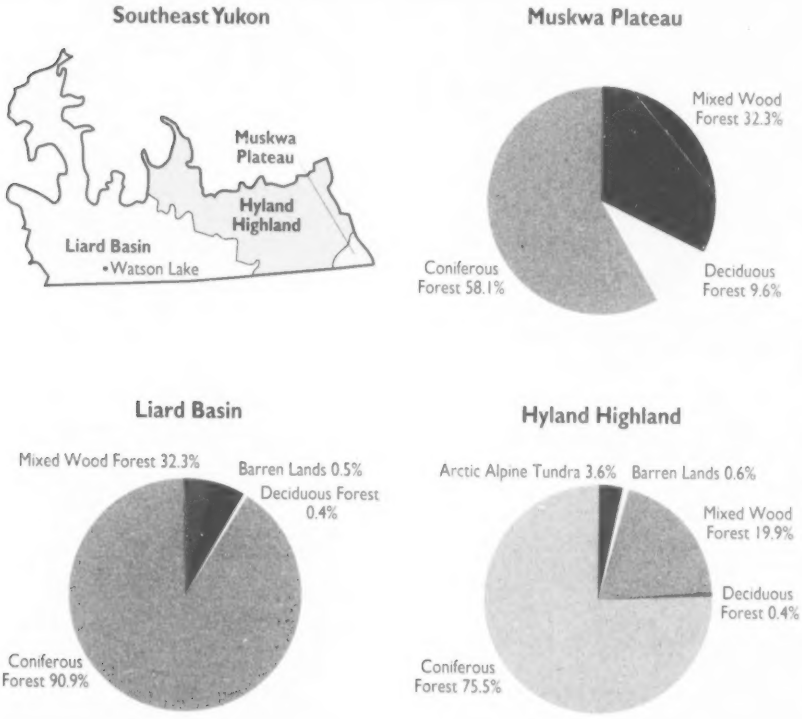
There is only one hard rock mine in the area. Sä Dena Hes was a lead-zinc mine which operated for a few years and is now closed. This mine provided employment to Watson Lake residents both at the mine and indirectly in the service sectors. Environmental concerns regarding road access to the mine and drainage from the tailings pond were addressed through the assessment and licensing process. There are no concerns about long-term impacts from acid rock drainage.

Southeast Yukon is the home of the Liard First Nation, a group with both traditional ties to the land and participation in the industrial economy. The First Nation owns one of the major forest companies in the region and has the only Timber Harvesting Agreement.

The relationships between tourism, mining, forestry, subsistence use and recreation in the southeast Yukon, and the effects of the various human activities on the environment, are complex. Tourism and recreation, for example, require relatively undisturbed natural areas; wildlife and subsistence use depend on protection of habitat and maintenance of wilderness.

The southeast Yukon reporting unit has diversified wildlife which includes moose, black bears, wolves, beavers, muskrats, snowshoe hares, waterfowl, cranes and grouse. There is one protected area: Coal River Springs Territorial Park, a small reserve which preserves thermal springs.

Figure 6.27
Land cover of ecoregions - Southeast Yukon

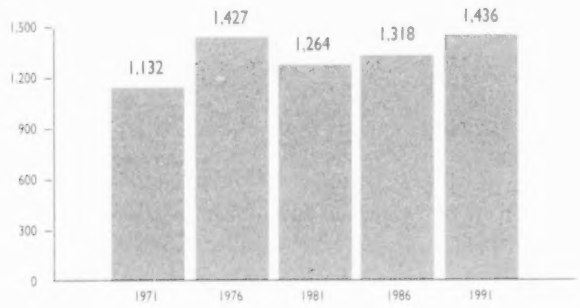


Challenges for Sustainable Forestry

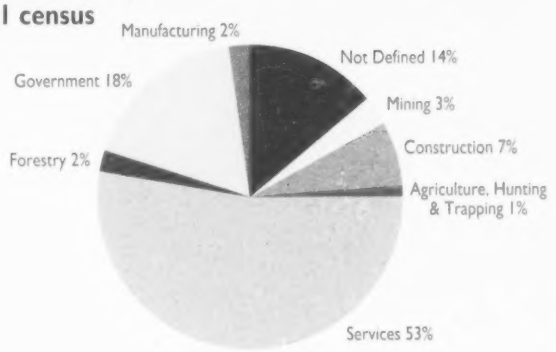
There are approximately three million hectares of forest land in the southeast Yukon (Figure 6.29). Most of the forests in this region are coniferous; white and black spruce and lodgepole pine are the most common tree species. The majority of forests in the southeast Yukon (54 per cent) are dominated by trees between 101-140 years old, with an additional 40 per cent of the forest dominated by trees between 61 and 100 years old. These large trees are especially valuable for timber production. The valleys of the Liard River and its tributaries support the most extensive, productive forests in the territory.

Figure 6.28
Population and employment - Southeast Yukon

Population of reporting unit, 1971 - 1991



Employment by sector, 1991 census



Community Populations December 1994

Watson Lake	1,749

Watson Lake's population includes the community of Upper Liard.

Employment by Sector, 1981 to 1991 Census

Sector	1981	1986	1991
Primary - (agriculture, hunting, trapping; mining; forestry)	40	45	60
Secondary - (manufacturing)	35	20	15
Tertiary - (government; services; construction)	515	630	715
Not Defined	45	50	125
Total	**635**	**735**	**910**

Forests in the Liard Basin are valuable in many ways. They provide moose winter range in the Yukon[1] and the mature forests provide habitat for marten, the most important furbearer harvested by trappers in the Watson Lake area. Forests are also important for recreation. Several of the rivers of this area, for example the Coal River and Liard River, are important for wilderness paddlers.

The stands of white spruce along the Liard River and its tributaries are a critical habitat for songbird populations dependent on old-growth forests.[2] In the Labiche and Beaver River valleys, white spruce mixed with deciduous trees and shrubs provide nesting habitat for several songbirds that are rare in the Yukon. Fieldwork in these valleys in 1995 documented six forest bird species not previously known to occur in the Yukon. Long-term migration monitoring in eastern North America shows that several of these species are declining (for example, the ovenbird and the Canada warbler).

Demand for Yukon timber has greatly increased recently and the policy and legislation framework for forest management is under review (see Section 5.2). Until recently, the largest timber harvest in Yukon history occurred in 1900 when 253,000 m^3 was harvested. In 1994/95,

1987 THE EIGHTIES

First Territorial Park

Yukon government established Herschel Island as the first territorial park, a requirement under the Inuvialuit Final Agreement.

Polar Seas (Icy Waters Arctic charr farm) fish farming project started up near Whitehorse.

a new record harvest of 329,098 m^3 was set in the Watson Lake district (Figure 6.30).

In attempting to design a sustainable forest industry, at least one element is clear. Timber harvests taken must be balanced by reseeding trees after cutting. The time scales are enormous. Slow growing conditions suggest that 100 years may be required for a forest to reach a size where it could be harvested again economically.[2] Yet until 1992, there was no replanting or silviculture program in the Yukon. Relying on natural seeding to replace harvested trees is not always successful.[3] As a result, there are an estimated 2,000 hectares of forest lands that have not been satisfactorily restocked.[4]

Most of the timber harvested for commercial purposes in the southeast Yukon is sold by the Crown at a rate of \$0.20/m^3 through a one-year Commercial Timber Permit. The remaining timber in this area is harvested under multi-year Timber Harvest Agreements and rates vary between \$1.75/m^3 and \$66.30/m^3.

Reforestation is not required after harvesting timber under a Commercial Timber Permit. The Canada-Yukon Cooperative Agreement on Forestry Development recently provided funding to plant seedlings in some of the cutblocks harvested under previous Commercial Timber Permits; approximately 800,000 seedlings have been planted since 1992. Reforestation is a requirement under the Timber Harvest Agreement and 200,000 seedlings have been planted so far (see Section 5.2).

- A management level timber inventory has been completed, and an Allowable Annual Cut is currently being calculated for this region.
- Development of a forest management plan for the southeast Yukon was initiated in 1990. When completed this plan will provide guidance for forest industry operations.

In 1992, fieldwork was begun to prepare an ecosystem classification guide for the southeast Yukon. This is critical information because management decisions (such as harvests and silviculture plans) must reflect the differences in ecosystems that occur across the landscape.

Figure 6.29
Forest cutting areas

Most of the forest cutting areas in the Yukon are in the Watson Lake region, as shown below. There is a cutting area in the LaBiche in the far corner of southeast Yukon (not shown).

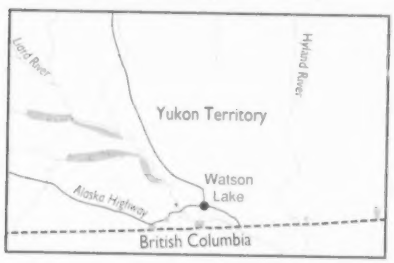
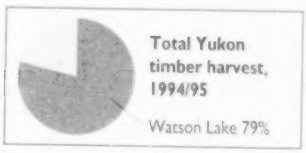
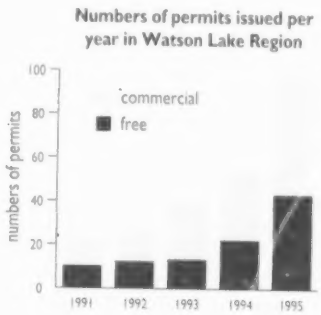
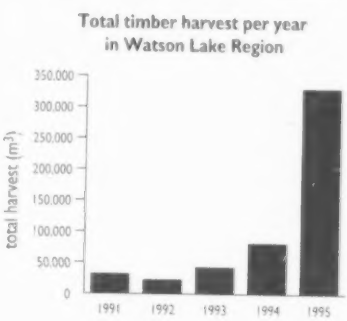


Figure 6.30
Watson Lake forest region timber harvest, 1990-95

Note: Data years run from April 1 to March 31. For example, the year marked 1991 is actually April 1, 1990 to March 31, 1991.



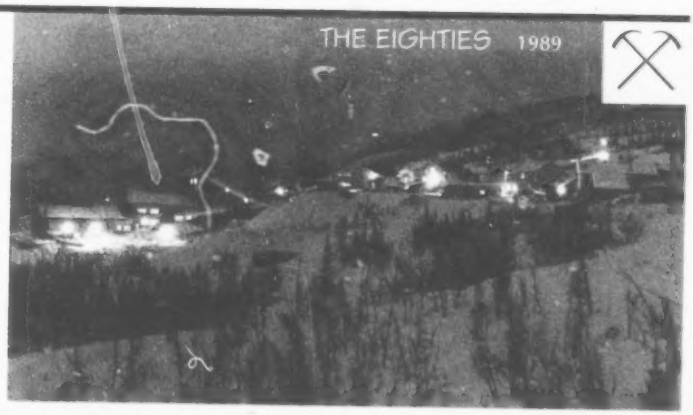




Freshwater Fish Transfer

Management of freshwater fisheries was transferred from the federal to the Yukon government.

United Keno Hill Mines at Elsa closed. It was one of the oldest silver ore producers in Canada and the Yukon's longest operating mine.



Elsa at night, c. 1937
Yukon Archives/Schellinger Coll.

Figure 6.28
Population and employment - Southeast Yukon

Population of reporting unit, 1971 - 1991

Employment by sector, 1991 census

Community Populations December 1994

Watson Lake	1,548
Rancheria, Upper Liard, Swift River, Lower Post, Good Hope Lake	249

Employment by Sector, 1981 to 1991 Census

Sector	1981	1986	1991
Primary (agriculture, forestry, trapping, mining, fishing)	40	45	60
Secondary (manufacturing)	35	20	15
Tertiary (government services, construction)	515	630	715
Not Defined	45	50	125
Total	635	735	910

1987

Herschel Island Territorial Park

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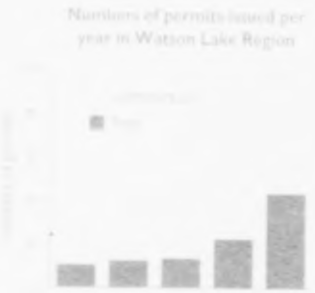

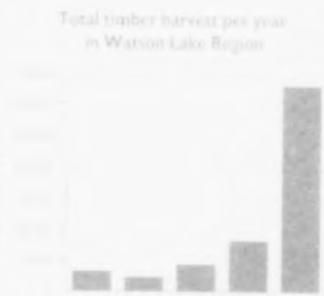

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United Keno Hill Mines at Elsa closed. It was one of the oldest silver ore producers in Canada and the Yukon's longest operating mine.

Elsa in 1937
Yukon Archives Schellinger Coll.

Glossary

Words in italics are defined or explained elsewhere in the glossary.

acid rock drainage: Low-*pH* drainage water from certain types of rock, usually caused by the oxidation of sulphides to sulphuric acid. May be from natural rock outcroppings or may be associated with mining. Acid rock drainage can become neutralized and usually contains high concentrations of metal ions.

allowable annual cut: The amount of timber that is permitted to be cut annually from a specified area. Usually expressed as cubic metres of wood.

anadromous fish: Fish that live part of their lives in the sea and swim up freshwater streams to spawn.

aquaculture: The cultivation of fish.

aquatic: To do with marine or freshwater *ecosystems*.

aquifer: A layer of rock or soil that holds or transmits *groundwater*.

biodiversity (biological diversity): The term describing the variety of life on Earth. It refers to all animals, plants, and microorganisms in terrestrial, freshwater, and marine *ecosystems*. It includes three levels: species, ecosystem, and genetic diversity. It emphasizes the complex relationships among all living things on Earth.

biomass: Quantity of living matter in a defined area expressed in units of living or dried organic matter.

carbon dioxide (CO_2): One of the *greenhouse gases*, which is released to the atmosphere by both natural and human activities. Although it is reabsorbed by the biosphere in 50–200 years, while in the atmosphere it is an effective radiator of energy and contributes to the *greenhouse effect*.

carbon monoxide (CO): A colourless, odourless and tasteless gas released primarily by incomplete combustion of *fossil fuels* (especially by automobiles).

CFCs (chlorofluorocarbons): A group of simple gaseous compounds that contain carbon, chlorine, fluorine, and sometimes hydrogen. Several forms of these gases are artificially produced and have been used as refrigerants, aerosol propellants, and cleaning solvents and in the manufacture of plastic foam. They are suspected of causing *ozone* depletion in the *stratosphere* and, being effective radiators of energy, are strong *greenhouse gases*.

climate change: An alteration to measured quantities (e.g., precipitation, temperature, radiation, wind, cloudiness) within the climate system that departs significantly from previous average conditions and is seen to endure, bringing about corresponding changes to *ecosystems*.

coliform bacteria: Group of bacteria mainly inhabiting the intestinal tracts of humans and other warm-blooded animals. The total and faecal coliform groups are commonly used as *indicators* of the sanitary quality of water, because the presence of these other microorganisms in drinking water can result in diseases.

conservation: The management of human use of *ecosystems*, *species*, and *genetic diversity* so that they yield sustainable benefits for current generations while maintaining the potential for future generations to meet their needs and aspirations.

contaminant: Any potentially undesirable substance (physical, chemical or biological). Usually refers to the introduction of harmful substances, human-made or naturally-occurring. However, some substances that may have harmful

1990 THE NINETIES

Falcons Make Comeback

Peregrine falcon population increased, 60-100 pairs produced young.

Action on Waste

1991 Evaluation and clean-up of Yukon waste sites began under the federal Arctic Environmental Strategy.

1991 Environment Act passed by Yukon Legislative Assembly.

effects at high levels (such as metals) occur naturally in ecosystems and may also be introduced through human activities.

country foods: A diet of local meat, fish and wild plants obtained through subsistence harvest.

cumulative effect: The effect on the environment from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions.

DDT (dichlorodiphenyl-trichloroethane): Synthetic *organochlorine* insecticide introduced for widespread use just after World War II. Used for mosquito control in the Yukon until the early 1970s. No longer used in Canada, but still used in other parts of the world.

degree-days: The difference, in Celsius degrees, between the air temperature for a given day (usually the mean daily temperature) and an established reference temperature. **Growing degree-days** are used as an index of growth potential in agriculture and are commonly calculated as the number of Celsius degrees by which the mean daily air temperature exceeds 5°C.

dioxins and furans: Dioxin is the popular name for a class of *organochlorine compounds* known as polychlorinated dibenzo-p-dioxins. Furans (polychlorinated dibenzo-furans) are also organochlorine compounds. Only a few of these compounds are highly *toxic*. Dioxins and furans are formed either as by-products during some types of chemical production that involve chlorine and high temperatures or during combustion where a source of chlorine is present. Dioxins can occur in airborne *particulate* material from incinerators that burn trash containing chlorinated compounds and in exhaust from diesel engines.

drainage basin: See *watershed*.

ecoregion: For land areas, *ecosystem* units defined in the ecological land classification system for Canada; for marine areas, ecosystem units defined in the marine ecological classification system for Canada. For both systems, ecozones are the largest units. These are subdivided into progressively smaller units based on ecological characteristics such as climate, soil or water properties, and wildlife. Each ecozone is subdivided into ecoregions. The reporting units in Chapter 6 are groupings of ecoregions.

ecosystem: A dynamic complex of organisms, including humans and their physical environment, interacting as a functional unit. Ecosystems vary in size and composition. The term may be applied to a unit as large as the entire ecosphere or to smaller divisions like the Arctic or even small lakes. In its broadest sense, an ecosystem includes environmental, social, and economic elements. The root words of ecosystem are *eco*, a derivative of the Greek term for house or home, and *system*, which addresses the relationships and connections between the biological and physical parts.

effluent: A liquid that is a by-product of human activity (e.g., liquid discharge from mineral processing or sewage), which may be discharged into *ecosystems*.

endangered: In this report, this term refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The designation is assigned to any indigenous *species*, subspecies, or geographically separate *population* that is at risk of imminent extinction or extirpation throughout all or a significant portion of its Canadian range. See also *extinct*, *extirpated*, *threatened*, and *vulnerable*.

environment: The components of the Earth, including air, land, and water, all layers of the atmosphere, all organic and inorganic matter and living organisms, and the interacting systems that include all of these components. Everything that surrounds and affects or influences an organism or a group of organisms; it includes both living and nonliving components as well as both natural and human-built elements. See also *ecosystem*.

environmental assessment: The critical appraisal of the likely ecological effects of a proposed project, activity, or policy, both positive and negative.

erosion: The wearing down and movement of soil, rock fragments and bedrock by the action of moving water, glaciers and wind.

1992

Thirtymile River designated a Canadian Heritage River.

Skidoo Parts Worth More Than Furs

Lynx was the main fur. Wolverines, marten, some fox. Sometimes you could catch a coyote when don't want them and squirrels were good prices one time. You could survive with those prices years ago. Not like today. You would spend more money on gas and skidoo parts than you would take in. And another thing is your rabbits are gone and most animals are starving now.

— Billy Blair, Beaver Creek Elder

exotic (also known as **alien**, **introduced**, or **nonnative**): Refers to any organism that enters an *ecosystem* beyond its normal range through deliberate or inadvertent introduction by humans.

extinct: In this report, this term refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The designation is assigned to any indigenous *species*, subspecies, or geographically separate *population* formerly indigenous (native) to Canada that no longer exists anywhere. See also *endangered*, *extirpated*, *threatened*, and *vulnerable*.

extirpated: In this report, this term refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The designation is assigned to any indigenous *species*, subspecies, or geographically separate *population* no longer existing in the wild in Canada but occurring elsewhere. See also *endangered*, *extinct*, *threatened*, and *vulnerable*.

flyway: A geographic migration route for birds, including the breeding and wintering areas that it connects. The **Pacific Flyway**, one of four in North America, runs north–south along the mountainous areas of the west.

food chain: A food relationship in an *ecosystem* in which energy and *nutrients* are transferred through a series of organisms by each stage feeding on the preceding one and providing food for the next stage.

fossil fuels: Oil, gas, coal, and other fuels that were formed under the Earth's surface from the fossilized remains of plants and tiny animals that lived millions of years ago.

fragmentation: The disruption of extensive *habitats* into isolated and small patches.

genetic diversity: The infinite variation of possible genetic combinations among individuals. Genetic diversity is what enables a *species* to adapt to ecological change.

global warming: See *greenhouse effect*.

greenhouse effect: The preservation of warmth in the Earth–atmosphere system caused by the presence in the atmosphere of certain gases (e.g., water vapour, *carbon dioxide*) that transmit shortwave energy (visible and *ultraviolet radiation*) to the Earth's surface and temporarily absorb and retain heat radiating from the surface, thereby retarding the loss of energy to space. The greenhouse effect has been a property of Earth's atmosphere for millions of years, but human activities have added to the amount of atmospheric *greenhouse gases* over recent years. Any increase in warming resulting from human activity is referred to variously as the **enhanced greenhouse effect**, **greenhouse warming**, **greenhouse gas warming**, and **global warming**.

greenhouse gas: A gas that has strong capabilities to absorb longwave energy in the atmosphere and reradiate it, thus contributing to the *greenhouse effect*.

gross domestic product (GDP): The unduplicated value of production originating in a region (the Yukon, in this report).

groundwater: Water occurring below the ground surface, which may supply water to wells and springs. Groundwater occupies pores, cavities, cracks, and other spaces in bedrock and unconsolidated surface materials. See *aquifer*.

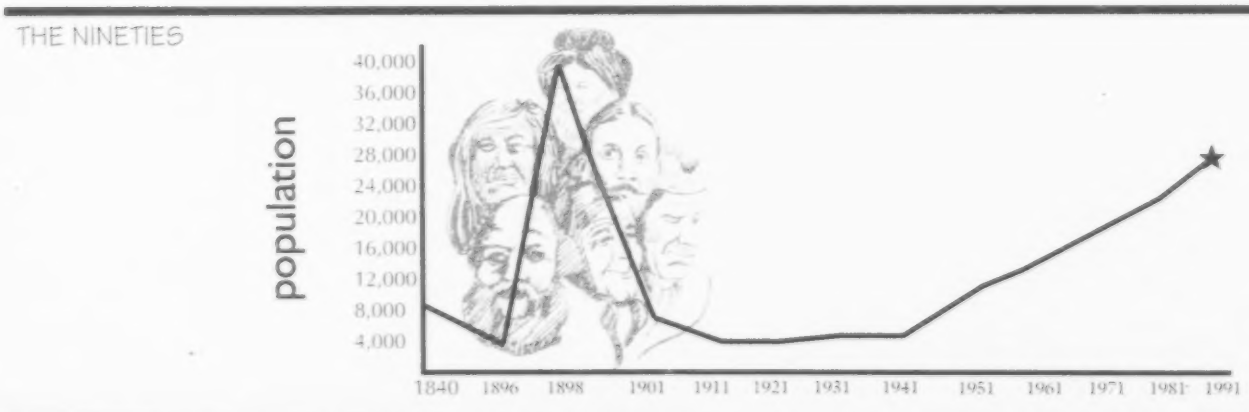
habitat: The place or type of site where plant, animal, or microorganism *populations* normally occur. The concept of habitat includes the characteristics of that place (such as climate, the availability of water, nutrients and shelter) which make it especially well-suited to meet the life cycle needs of the particular organism.

hardwood: Trees that are generally broadleafed and deciduous, such as aspen, poplar, birch.

hazardous waste: Waste that poses a risk to human or ecological health and requires special disposal techniques to make it harmless or less dangerous. Also called **special waste**.

hectare: Measurement of area of land. One hectare = 100 metres x 100 metres or 2.47 acres.

ice age: A cooling of the global temperature by about 5°C below present values can maintain ice



sheets over mid- to high-latitude continental surfaces. This has occurred on several occasions over the past 2 million years. Ice ages are separated by interglacial periods, such as the present Holocene period, which has lasted 10,000 years.

indicator: A measure that, tracked over time, provides information on trends in the condition of a phenomenon and has significance extending beyond that associated with the properties of the statistic itself. **Environmental indicators** focus on trends in environmental changes, the stresses that are causing them, how *ecosystems* and their components are responding to these changes, and societal responses to them.

intrinsic value: The worth of an entity independent from external circumstances or its value to humans; value judged on inherent qualities of an entity rather than value to other entities.

leaching, leachate: Rainwater running through the soil dissolves mineral *nutrients* and other substances (including any water-soluble contaminants) and carries them via *groundwater* into water bodies.

loadings: Total mass of contaminants to a water body or to the land surface over a specified time (e.g., tonnes per year of phosphorus).

long range atmospheric transport: The process whereby contaminants (especially *organochlorine compounds* and metals) enter the atmosphere through effluents or from evaporation from soils or water bodies, move through the Earth's atmosphere and return to the Earth at a different location attached to dust particles, rain or snow. The contaminants then move through *ecosystems* and often accumulate through the *food chain*. Also refers to movements of contaminants through the oceans.

methane (CH_4): A *greenhouse gas* emitted to the atmosphere from ecological sources such as *wetlands* but also from a number of human-caused sources, including manure deposits, rice paddies, municipal dumps, coal mines, and leaks from gas wells and pipelines. Although an effective energy radiator, methane has a relatively short residence time in the atmosphere (a decade).

mixedwood: A forest stand composed of hardwood and softwood trees.

monitoring: The process of checking, observing, or keeping track of something for a specified period of time or at specified intervals.

nitrogen oxides (NO_x): A group of gases released by *fossil fuel* combustion, forest fires, lightning, and decaying vegetation. **Nitrogen dioxide (NO_2)**, a reddish-brown gas with an irritating odour, is one of the key ingredients in smog.

nonnative: See *alien*.

non-point source: Source of *pollution* in which pollutants are discharged over a widespread area or from a number of small inputs rather than from distinct, identifiable sources. Examples include eroding lands stripped during mineral exploration or mining, urban lands, and logged forestlands. See also *point source*.

nutrient: Any element or compound that an organism must take in from its *environment* because it cannot produce it or cannot produce it as fast as it needs it. As pollutants, any substance or group of substances (e.g., phosphorus or nitrogen) that, if added to water in sufficient quantities, provides nourishment that promotes the growth of so much aquatic vegetation that the quality of those waters is affected.

old-growth forest: A stand of mature and overmature trees relatively uninfluenced by human activity. The stand can contain multiple layers of tree canopies and various *species* of trees, a significant number of which are huge and long-lived. Such a forest also usually has many large, standing dead trees and numerous logs lying about the forest floor.

organochlorine compounds: Chlorine-containing organic compounds, which may contain oxygen and other elements, such as phosphorus. The term includes many *pesticides* and industrial chemicals. Examples are *dioxins and furans, PCBs, DDT, and toxaphene*. Many of these kinds of compounds tend to be *persistent*, meaning that they do not break down easily in *ecosystems*.

ozone (O_3): A gas composed of three atoms of the element

Wind Power

THE NINETIES 1994

1993 Haeckel Hill Wind Turbine alternate energy project initiated.

1993 Creation of Vuntut National Park, a requirement under the Yukon Final Agreement.

1993 Yukon Environment Act proclaimed.

1994 Whitehorse Copper Tailings Pond Rehabilitation Project initiated.

Raising the windmill on Haeckel Hill.
Yukon Energy Corp./Yukon Electrical Co. Ltd.

oxygen. In the lower 10 kilometres of the atmosphere, it occurs as a *pollution* product formed by combining *nitrogen oxides (NO$_x$)* and volatile organic compounds (VOCs) in the presence of sunlight. In this portion of the atmosphere, it is also a *greenhouse gas*. Above 20 kilometres, it is produced naturally and protects the Earth from damaging *ultraviolet radiation*. See also *stratosphere*.

Pacific flyway: See *flyway*.

PAHs (polycyclic aromatic hydrocarbons): Among the oldest known carcinogens in humans, PAHs are released into *ecosystems* from atmospheric emissions, especially the burning of *fossil fuels*. Sources include thermal power plants, sewage, wood smoke, and used lubricating oils.

particulate: Anything that can be filtered from the air. Large particles, such as road dust or pollen, can irritate the eyes, whereas smaller particles (often called "fine particulates") from smoke and fumes can be inhaled into the lungs.

PCBs (polychlorinated biphenyls): An organochlorine compound used as an industrial oil particularly in electrical transformers and capacitors. There are 209 different types of PCB molecules, of which a few are particularly toxic. No longer manufactured or sold in Canada and being phased out of use.

permafrost: Perennially frozen layer in the soil, found in alpine, Arctic, and Antarctic regions.

persistent: Refers to chemical compounds, such as many *organochlorine compounds*, that do not break down easily in *ecosystems*.

pesticide: A substance, usually chemical, used to kill unwanted plants and animals. Includes herbicides, insecticides, algicides, and fungicides.

pH: A numerical expression of the concentration of hydrogen ions in solution: low pH (0–6.9) is acidic, pH 7 is neutral, and high pH (7.1–14) is basic or alkaline.

point source: A source of *pollution* that is distinct and identifiable. Includes smokestacks and outfall pipes from mines or industrial plants and municipal sewage treatment plants. See also *non-point source*.

pollution: The release by humans, directly or indirectly, of substances or energy into *ecosystems* that harms living resources and life, is hazardous to human health, hinders human activities, impairs the quality of the ecological resources, and or reduces amenities.

population: A group of organisms of the same *species* living within a specified region.

productive forest land: Forested land that is biologically capable of producing merchantable timber within a defined period of time.

protected area: Geographically defined area that is designed or regulated and managed to achieve specific *conservation* objectives.

recyclable: Refers to such products as paper, glass, plastic, used oil, and metals that can be reprocessed instead of being disposed of as *waste*.

recycling: Set of processes for reclaiming, as a material input to a product or service system, material that would otherwise be disposed of as *waste*.

silviculture: The theory and practice of controlling the establishment, composition, growth, and quality of forest stands to achieve certain management objectives.

softwood: Cone-bearing trees with needle or scale-like leaves such as spruce, pine, fir, larch.

species: A group of related individuals with common characteristics and way of life, separated from neighbouring groups by a barrier that is generally sexual in nature – members of different species do not normally interbreed, and, if they do, the progeny are sterile.

species diversity: Refers to the total number of different *species* in a given area.

stratosphere: The layer of the atmosphere between about 10 and 50 kilometres above the Earth's surface within which temperatures rise with increasing altitude. Contains **stratospheric ozone**, which absorbs potentially harmful *ultraviolet radiation*.

sustainability: The ability of an ecosystem to maintain ecological processes and functions, biodiversity, and productivity over time.

1995 THE NINETIES

Grum Opening

Stripping the Grum lead-zinc deposit at Faro began.

Yukon Govt. Public Affairs

sustainable harvest rate: A rate of harvest that is within an *ecosystem's* natural ability to recover and regenerate.

sustainable use: Use of components of *biodiversity* (i.e., organisms or *ecosystems*) in a way and at a rate that does not lead to the long-term decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

tailings: Material rejected from a mill after most of the recoverable valuable minerals have been extracted. Tailings are generally finely ground rock particles that are transported as a water slurry to a storage area, known as a **tailings pond**, at the mine site. Usually the tailings composition is similar to the parent ore body and may therefore contain metals, sulphides or salts.

threatened: In this report, this term refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada. The term describes any indigenous *species*, subspecies, or geographically separate *population* that is likely to become *endangered* in Canada if the factors affecting its vulnerability are not reversed. See also *endangered*, *extinct*, *extirpated*, and *vulnerable*.

toxaphene: $C_6H_{10}Cl_8$; *toxic organochlorine compound* used as an insecticide on cotton fields. Also used to kill unwanted fish in lakes prior to lake stocking. No longer used in Canada, but still used in other parts of the world. Generally the main organochlorine compound found in Yukon fish tissues from *long range atmospheric transport*.

toxic: Pertains to any substance entering the *environment* in a quantity or concentration or under conditions that may have an immediate or long-term effect on the environment or that may constitute a danger to human life or health.

toxicity: The inherent potential or capacity of a material to cause adverse effects in a living organism.

trend: A change that persists over time.

ultraviolet radiation: Electromagnetic radiation in the wavelength range 4–400 nanometres; this range begins at the short-wavelength limit of visible light and overlaps the wavelengths of long x-rays (some scientists place the lower limit at higher levels – up to 40 nanometres). Also known as **ultraviolet light**.

vulnerable: In this report, this term refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The term describes any indigenous *species*, subspecies, or geographically separate *population* that is particularly at risk because of low or declining numbers, small range, or some other reason but is not a *threatened* species. See also *endangered*, *extinct*, *extirpated*, and *threatened*.

waste: Any output from the product or service system that is disposed of.

waste rock: Valueless rock (unmineralized or weakly mineralized) that must be fractured and removed to gain access to ore. It may contain low concentrations of metals or sulphides and is often stored in **waste dumps** on site.

watershed: an area of land that drains naturally into a stream or other waterway.

wetland: Land that has the water table at, near, or above the land surface or that is saturated for a long enough time to promote wetland or *aquatic* processes and various kinds of biological activity that are adapted to the wet *environment*. Includes fen, bog, swamp, marsh, and shallow open water.

Whitehorse Star

Land Claims Legislation Passed

February 14, Land Claim Legislation Passed into law.

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Elders' words quoted in the text, unless otherwise noted, are from transcripts of interviews and meetings and are used with permission of the author. Interviews and meetings were conducted in the course of development of this report and through the Council of Yukon First Nations' Elders Documentation Project. Ron Morberg of the Elders Council and Bob Charlie of Cracker Creek Productions coordinated this work.

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Timeline

Notes:

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